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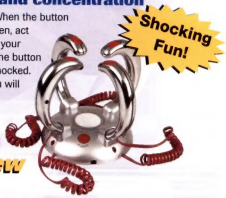

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PUBLISHER'S LETTER

Compact fluorescent lights are not economic

While most people don't worry at all about their electrical energy consumption, more and more people are becoming efficiency conscious and are doing as much as they can to save electricity. One recommended way of doing this has been to install compact fluorescent lamps (CFLs) in place of standard incandescent lamps. All the electricity authorities promote the use of CFLs and indeed, Sydney's "Energy Australia" is currently giving away CFLs to domestic customers.

On the face of nominal power consumption ratings, a CFL is a far better proposition than an incandescent. For example, a 15W CFL is typically quoted as having a light output equivalent to a 75W incandescent lamp.

That's a big saving in energy and and easily justifies the much higher price of CFLs, in view of their much longer rated life which is typically quoted as five to eight times the life of an incandescent lamp. But in our experience and the experience of many others, they simply don't last that long. In fact, our experience has been that they often don't even last as long as a typical incandescent lamp.

Think about it. Given a few hours use a day, an incandescent lamp can be expected to last about a thousand hours or about a year. If your mains voltage is high, it can be a lot less and if it is low, an incandescent can last for years. On that basis, if a CFL is conservatively rated at five times the life of an incandescent, ie, 5000 hours, it should last for five years or more.

Two brands in front of me at the moment (GE and IGA Evanmax) quote an expected life of 8000 hours. That's a very long time. So how many readers can categorically state that they have had a CFL last for 5000 hours or more? Not many, I would bet.

In my experience, they can fail much sooner than a typical incandescent because of outright failure of the ballast electronics or the tube itself fails. Not good. In fact, we tried a succession of CFLs here in our office to replace incandescents which were on all day, five days a week. We were lucky if the CFLs lasted a few weeks. My impression was that the CFLs were possibly failing because of spike voltages superimposed on the line. And maybe that's what causes their early failure in domestic use as well.

When you are paying $10 or more for a CFL you expect them to last a very long time, perhaps even longer than a typical 36W fluorescent tube. 36W tubes in our office would probably last about three years at best and that would be about 7000 hours. But 36W tubes are much cheaper than CFLs.

CFLs have recently become much cheaper and some of the hardware chains have had them down to few dollars. But in my opinion, unless you get them as a giveaway from your local electricity distributor, "they're not worth a candle". Which is a great pity because the concept is good.

Next time you go out to buy a CFL, take note of any lifetime claims on the packaging, keep your receipt and the packaging, and be prepared to ask for a refund or replacement if the unit fails prematurely. Otherwise, you could be throwing your money away.

Leo Simpson

More great bits 'n pieces from MicroGram

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This USB Net phone allows users to make free calls with programs such as Skype (www.skype.com) when connected to the internet.

Cat. 10129-7 $89

HOT PRICE

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Cat. 9180-7 $239

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MAILBAG

Saving the output transformer

On reading Rodney Champness' informative Vintage Radio section in the June 2004 issue, the text on pages 87 and 88 refers, amongst other things, to the problem of capacitor C11 becoming shorted. As the circuit of Fig.1 on page 85 shows, C11 connects from the plate of the output valve to ground. This is a quite common circuit design strategy to assist with (RF) stability and in tailoring the final audio-frequency response of the receiver.

Should C11 become shorted, it immediately pulls the plate end of the output transformer's primary winding to ground. One of the unfortunate side effects of this is that the full high-voltage DC supply (HT2) is then connected across the low-resistance primary winding. Not unexpectedly, this can result in a burned out (open-circuited) primary due to the excessive current flowing through it, after which both the transformer and C11 will need to be replaced.

There is a simple expedient which will forever prevent this destruction of the output transformer in radios of any type which share this circuit configuration. The solution is to connect C11 directly in parallel with the transformer's primary winding – an electrically equivalent arrangement. This is easily done by unsoldering the earthed end of C11 and connecting that end to the high tension line (HT2).

Now, not only will a future short in C11 not destroy the output transformer in the manner described above but the possibility of C11 shorting again is greatly reduced, due to the much lower static (DC) voltage across it.

Graeme Dennes, MIE Aust,
Pakenham, Vic.

Comment: that's an excellent suggestion. Wonder why those clever designers in the days of yore did not think of that!

Valves have definitely had their day

If Grahame Macpherson ("Valve Electronics Never Reached Its Peak", June 2004 Mailbag) dug a bit deeper he would find that in truth, valve technology and indeed circuit design were both highly developed before the silicon age. Valves were imaging, photo-multiplying, counting, displaying, microwave amplifying and even computing, before the first transistor.

The only obstacle with using a phase-locked loop (aka lock-in amplifier) was that first you had to design and build one using about a dozen valves, rather than just grabbing a CMOS PLL chip.

Think of a modern cell-phone with its computer, display and microwave transceiver, based on thermionic emission. The simple power density required for thermionic electron emission compared to solid state alone make it a non-starter.

Research into thermionic devices hasn't stopped, particularly in the area of display pixels. I'm crazy about valve guitar amplifiers but that's where it stops. When I'm playing keys, the last thing I want is a bunch of jingles and hiss from a 12AX7A. Gimme an LM833 any time - that's "blameless" enough.

Roly Roper.
via email.

DVD dubbing stymied by Macrovision

It was very interesting reading your June 2004 editorial regarding Macrovision on DVDs.

About five months ago, I purchased a Digitrex DVD recorder. The reason for the purchase was to copy all my old home movie camera films and later analog video camera recordings to DVD disks. The movie camera films and analog tapes had previously been transferred to VHS tapes (22 VHS tapes in total). Those tapes are now showing age and the quality of the images is bordering on "wishy washy". It was imperative to transfer them to DVD as soon as possible.

The many problems I encountered were frustrating to say the least. Some of the tapes had developed "sound bars" and whenever the DVD recorder encountered these, the recorder would cease recording and give a message stating stopped due to copyright protection.

These tapes are my own and not commercial movies or but the recorder does not see it that way. Every time I resumed recording, the recorder starts a new title. One disk ended up being 26 separate titles, even though the film was only 20 minutes in length.

Another lesser problem occurs while editing via the TV. After 10 minutes of continuous recording, the output to TV goes into black and white mode.

I contacted Digitrex in Sydney. The service contractors verified the problem and stated there was nothing they could do, due to Macrovision being built into the recorder. I then contacted Digitrex's sales manager and asked if there was any way to overcome the problem. He said to buy a video enhancer.

My response was "it is laughable that a sales manager would suggest that a customer buy another product to make his product perform as advertised. I want my DVD recorder to do the job it is supposed to do". Plus, I was not going to spend any more money.

The topic of Macrovision now makes me see "red". Your Dr Video (SILICON CHIP, June 2004) will probably solve my problems and I will await feedback but why should I have to purchase another product? I suggest that readers be wary when considering purchases of DVD recorders.

Rex Shepherd,
via email.

Expensive DIY loudspeakers not so attractive

The speaker design information

from **www.linkwitzlab.com** looks tempting unless you're an old cynic like me. Open baffle speakers as high performance items were around 40 years ago but were never really successful, although they had their strong adherents. For really good sound, the back wave from the driver must be suppressed unless it can be put to use as in a vented enclosure. At $US3800 a pair plus 60 hours labour, the Linkwitz design is unlikely to appeal to local "do-it-yourselfers", as you rightly replied to Paul Rohde (Mailbag, June 2004).

As you are well aware, there are many critical factors in quality speaker design and not much agreement among users. My own speakers are a 4-way active crossover design, mainly because separate amplifiers were needed to control the resonances which some of the drivers exhibited outside their specified operating range.

A friend wanted some really good speakers and was unimpressed with the commercial units on offer. We even listened to a pair of monster speakers (about 2.5 metres tall and entirely impractical for that reason alone) which retailed for, from memory, in the region of $30,000 and with a phenomenal power handling capacity. They were very disappointing in the mid-range; quite unclear and "fuzzy" considering the very high cost. I believe this to have been because of the use of a first-order filter to the mid-range driver. All the other speakers we heard had colouration or poor transient response, or any number of other problems.

The drivers are, of course, critical and we settled on Morel for the mid-range and tweeters. He already had a pair of Vifa woofers and while I think the Morel range would have been slightly better, I used the Vifa drivers because they were to be used only to 200Hz anyway. I was also impressed with the specifications for the Dynaudio range of drivers which I believe would have also performed quite well.

The cabinet was designed to minimise diffraction and was consequently too complex for home construction. The crossovers are 4th-order between tweeters and top mid-range, 3rd-order at the bottom mid-range and 2nd-order to the woofers. The crossover points are 200Hz and 2kHz. All inductors are air-cored and were hand wound as there were no suitable components readily available commercially.

The woofers and ports face rearwards and the internal design of the enclosures is such that sound absorbent material is not necessary, there being a minimum of parallel faces, with the use of baffles to minimise standing waves.

A cabinet maker provided very handsome enclosures for about $800 the pair, the drivers cost about $600 and the crossovers about $400. So, with other odds and ends, there was not much change out of $2000. My friend is very pleased with the result. The response is very smooth and the transient response and "sound stage" are excellent. This is about as inexpensive as really good speakers can be made for, in my opinion.

The cost, however, is unlikely to be attractive to many DIYers and the difficulty of making the enclosures is a big disadvantage. The only criticism we have had of the speakers is that they have no colouration and are too neutral. I always thought that was the very thing good speaker design should aim for! I am envious that they sound much better than my old 4-way speakers!

I'm sure you are correct in your view that most readers' budgets do not stretch to esoteric and expensive speaker designs.

Alan March,
via email.

Airway museums in Melbourne & Adelaide

Those whose interests were stimulated by the article on Instrument Landing Systems in your June 2004 issue may be interested in the Airways Museum near Melbourne, which has examples of airways equipment as described in your article. It also has communications equipment, photos and archival material concerning aircraft and airways activities spanning many years. Details are at **www.airwaysmuseum.com**

Information on a similar museum near Adelaide can be obtained by phoning Eric Kelly on (08) 8443 7651.

Ron Rye,
via email.

Atmel's AVR, from JED in Australia

JED has designed a range of single board computers and modules as a way of using the AVR without SMT board design

The AVR570 module (above) is a way of using an ATmega128 CPU on a user base board without having to lay out the intricate, surface-mounted surrounds of the CPU, and then having to manufacture your board on an SMT robot line. Instead you simply layout a square for four 0.1" spaced socket strips and plug in our pre-tested module. The module has the crystal, resetter, AVR-ISP programming header (and an optional JTAG ICE pad), as well as programming signal switching. For a little extra, we load a DS1305 RTC, crystal and Li battery underneath, which uses SPI and port G.
See JED's www site for a datasheet.

AVR573 Single Board Computer

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Mailbag: continued

Instrument landing systems have attitude

Congratulations on an excellent article on Instrument Landing Systems in the June 2004 issue. At Charles Darwin University, we are undertaking a research and development project using tablet computers for document deployment and other flight functions in aviation. The graduate research students we involve in this project have an excellent IT background but minimal background in flying, so this article will provide some of this background.

Having said that, I would also like to offer some small comment on the article, in that – probably as expected in any description of a highly procedural operation – there are three small errors that I noticed as follows:

(1) The diagram on page 12, section (4) indicates "continues until approaching the centre line, then turns to intercept ...". This is far from the whole story.

Depending on whether the procedure is a genuine DME arc intercept (a specified instrument procedure) or simply a manoeuvre chosen by air traffic control or the pilot to position from the inbound track to the final track, this is typically flown at just over 10 nautical miles from the runway. At that distance, an aircraft flying at a typical 150 knots covers just over 250 feet (76 metres) per second. On the localiser, the distance from full-scale deflection to centred amounts to only 2.5° offset, which at 10 (nautical) miles is about 2500 feet.

Thus, there would be only 10 seconds from seeing the needle move from full offset to having the aircraft lined up on final (a 90° turn). In instrument flying, turns are normally held to so-called "rate one" or 180° per minute. Following through from this, a rate one turn through 90° should take about 30 seconds. Anything faster and the martinis in row three get sloshed (rather than the passengers). Not good for the first class types!

What actually happens here is that the pilot uses a so-called lead bearing, from where he/she turns to intercept the final course at an angle of 30° or less, then uses the localiser needles to position on to the final approach course.

(2) The same diagram says "... Having followed the ILS as far as the middle marker ... the pilot must either..." see the runway and land, or get out of there (my re-phrasing). This is not correct. On a precision approach, the pilot follows the ILS to the minimum descent altitude, typically 200 feet above the runway.

It is this altitude which defines the missed approach point on a precision approach and certainly, this is close to the middle marker. Pilots receiving training to upgrade from visual to instrument flight ratings are taught to "bounce off" the minimum altitude. If they don't – if they go below this by only a few feet – they fail their instrument flight test. If they go much further below it without visual reference, they get a more serious reprimand!

(3) Page 17 calls the top middle instrument an "attitude indicator". It is more than this. It also indicates the bank of the aircraft and is an "artificial horizon" or AH.

By the way, I suspect that many of your readers share with me a love of technology. I once read of an American brain surgeon who said he was a simple person: "...never happier than guiding his fishing boat back through a fog-bound bay by radar".

I am the same. I have experienced landing an aircraft at Essendon (Melbourne) where we (myself, wife and two kids) broke out of clouds at treetop height to see the runway lights, then touched down just before midnight. I get the same thrill when I throw a few chips together with a bit of solder and the whole lot works. Wow!

Thanks for a great magazine,

Professor R.S.V. (Bob) Pascoe,
Head of School/Associate Professor (Computer Science),
School of Information Technology,
Charles Darwin University.

Daniel Field replies:

(1) The diagram in the article shows the intercept from a 20-mile DME arc. Professor Pascoe's argument is based on an intercept from 10 miles, where the localiser course width is only half that at 20 miles. So his argument does not really relate to what is in the article.

Second, he argues that a plane travelling at 250 feet per second and starting 2500 feet from the line being intercepted would have to make the 90° turn in 10 seconds. Basic geometry tells us that the plane would actually fly along an arc of radius 2500 feet. On a 90° turn, that arc would be about 3900 feet long and so the turn would actually take more than 15 seconds rather than just 10.

90° in 15 seconds is a "rate two" turn (double the "rate one" 180° per minute) which is certainly not unheard of and needn't spill any of the martinis (being consumed with seat backs upright and tray tables locked away!).

In fact, if you double the distance out to 20 nautical miles as shown in the diagram, then the intercept manoeuvre would start twice as far from the line, giving the pilot a very nice, standard, "rate one" turn.

Having defended the diagram I must concede that Professor Pascoe's point about the "lead bearing" is quite right. When intercepting the localiser, it is more usual to intercept it at a shallow angle. A shallow intercept is less prone to errors such as overshoot. In drawing the diagram, it was a balance between simplicity, accuracy, and illustrating the point (viz, how VOR, DME and ILS can be used).

Perhaps I should have called it a "Possible ILS Approach" rather than a "Typical ILS Approach".

(2) I fully accept Bob Pascoe's point here. My background is technical not operational, so I can sometimes miss the details that are part of operational practice.

(3) Ah yes, the "whatsamacallit". The artificial horizon goes by more aliases than a KGB spy. One textbook lists the correct names for this instrument as bank and pitch instrument, artificial horizon, gyro horizon, attitude indicator and attitude gyro. It gets even more interesting once extra functions are added, with names such as director horizon, command indicator, flight director and attitude director indicator, denoting the addition of Autopilot functions (to name but one example).

The name "Artificial Horizon" (or

simply "AH") is certainly the most common. "Attitude Indicator" usually refers to any instrument that gives information about the pitch and roll attitudes of the aircraft. Professor Pascoe has interpreted the word "attitude" in its limited sense of "pitch attitude" only (which is certainly the most important attitude to a pilot). The artificial horizon displays both pitch and roll attitude, so it is perfectly reasonable to call it an attitude indicator.

But to be completely truthful, the reason I left it as attitude indicator (rather than the more widely used "Artificial Horizon") was to accommodate your layout artist's (Ross Tester) little joke. Since "Attitude Indicator" is not actually incorrect, I thought it would be nice to leave it in.

Silent PCs need not have fans

I read your article on silencing PCs in the July 2004 issue with interest. Noisy PCs are not a new phenomenon. I recall using one of the early IBM PCs and it reminded me a jet aeroplane taking off.

In your articles, you focused exclusively on how to build a top-of-the-line system that did not require you to wear earmuffs. There is an alternative approach – start with a system that doesn't need forced-air cooling.

For example, VIA make a range of CPUs that don't need active cooling. While they are only the 500-800MHz region, this is plenty fast enough for normal multi-media or office work. The power consumption is low enough that the power supply doesn't need a fan either, so the only moving part is the disk drive. You can build a whole PC that needs less power than a top-end CPU. For details see: **www.mini-itx.com**

You can buy them locally at (eg): **www.traverse.com.au**

Also, you mention cleaning the heatsink compound off when changing heatsinks. Some heatsink compounds may include beryllium oxide. This is highly carcinogenic and you should be careful to avoid contact with it.

Peter Jeremy,
via email.

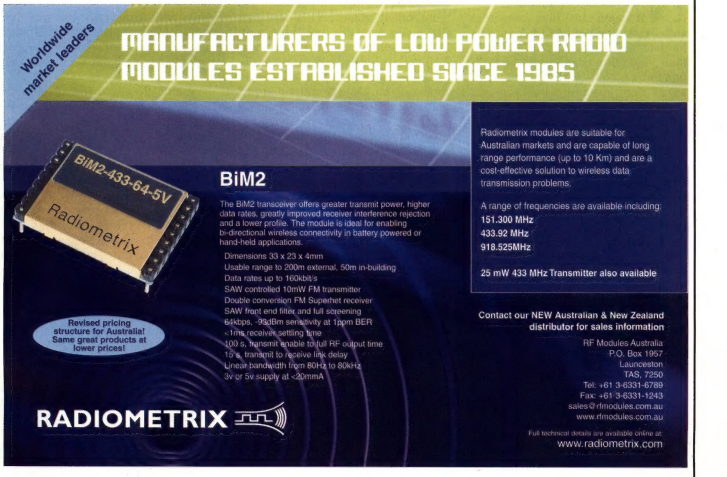
Cheap humidity sensor

In your June 2004 issue on page 91, M. H. asks about the availability of a cheap humidity sensor.

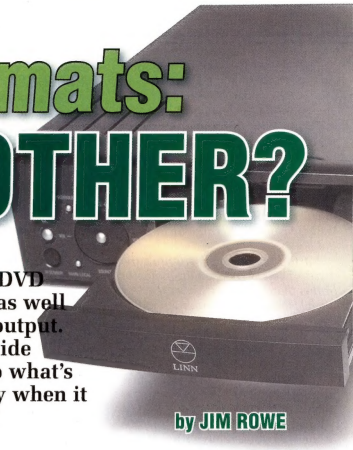
There may be an answer on page 403 of the 2004 Jaycar catalog. Cat. QM-7204 shows a Thermometer/Hygrometer "gadget" that sells for $27.95. This little beauty must have some sort of humidity sensor in it. Careful dismantling and "reverse engineering" could yield a useful humidity sensor, along with a temperature sensor (unless everything inside is integrated onto one big chip).

Anyway, $28 is a small investment and may solve the need for a Picaxe datalogger. If not, just put it back together and you still have a useful gadget.

Brad Fuller,
via email.



Video Formats: WHY BOTHER?



You've no doubt noticed that most DVD players have an "S-video" output, as well as the familiar "composite" video output. And many newer models also provide outputs for "component" video . So what's the reason for this extra complexity when it comes to video signal connections?

by JIM ROWE

NOT SO LONG AGO, video was just video – or that's the way it seemed. Video monitors and TV sets had single RCA sockets for their video inputs, as did VCRs for their video inputs and outputs. With this format, you simply fed the video signal from one unit to another via a single RCA-to-RCA coaxial cable, with other cables only needed for the audio.

When Laser disc players came along, most of them used exactly the same arrangement (although they gave much clearer pictures than VCRs). However, when DVD players arrived, even the early models had an extra video output socket (usually a 4-pin mini DIN socket) which was marked "S-video". At the same time, TV sets also started to appear with an S-video input socket – this in addition to the more familiar RCA-type video input, which was now being called the "composite video" socket.

So you now had a choice when it came to connecting a DVD player to the TV – use either a single RCA-RCA cable or one of the new 4-pin DIN to 4-pin DIN "S-video" cables. And the word soon spread that using an S-video cable gave better picture quality.

Then things got a little more complicated again. Some of the higher-end DVD players started to appear with a third kind of video output known as "component video". This was usually made available via three more RCA sockets marked Y, Cb (or Pb or B-Y) and Cr (or Pr or R-Y). Naturally, component video inputs also began appearing on TV sets and video projectors at about this time, giving the consumer yet another choice when it came to connecting video signals.

As before, word soon spread that using component video cables gave the best possible picture quality – even better than S-video. And it wasn't too long before component video outputs appeared on even low-end DVD players.

So what's it all about? Why have video connections become so complicated and do the fancy, newer formats really deliver better picture quality than good, old composite video? Let's find out!

About composite video

First of all, let's talk about composite video. As the name suggests, this really isn't just one signal but is a "composite" or a collection of a number of signals (or components).

First, there's the black-and-white or "luminance" (Y) video component, which conveys the basic picture detail and contrast information. Then there's the "chrominance" (C) video component, which conveys the picture's colour information (the chrominance component is itself actually two components, not one, but we'll go further into this shortly).

Finally, there are the synchronising pulses and the colour subcarrier burst pulses, which collectively form a third component in the composite video signal.

Although these components are all lumped together and sent along a single coaxial cable, they really are different video signal components with distinctly different functions. But why were they originally all lumped together to produce composite video signals in the first place?

The answer to this is that when TV broadcasting began, engineers needed to pack all of the video components into a single video signal to be modulated onto the TV station's radio carrier (along with the sound signals, of course). This also meant that when the TV signals were demodulated again in the TV set, they reappeared initially as the same composite video signal.

In the TV set itself, the composite video signal then had to be split up into its various components before the pictures could be displayed on the

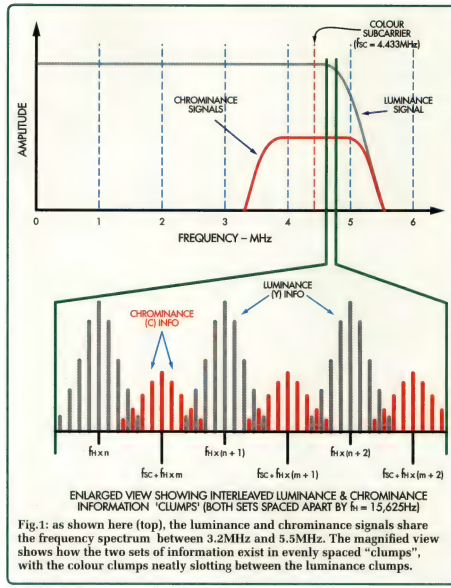


Fig.1: as shown here (top), the luminance and chrominance signals share the frequency spectrum between 3.2MHz and 5.5MHz. The magnified view shows how the two sets of information exist in evenly spaced "clumps", with the colour clumps neatly slotting between the luminance clumps.

screen. First, the luminance information had to be extracted so that it could be used to vary the three picture tube beam currents together (ie, from the three "guns"), to recreate the picture contrast and details.

Second, the chrominance information had to be extracted so that it could be used to control the beam currents individually, to recreate the picture colours. And third, the synchronising pulses and colour burst information had to be extracted so that it could be used to lock the picture scanning oscillators and ensure that the colour information was decoded correctly. Whew!

When VCRs subsequently came along, the easiest way to handle the video information that they fed to a TV set was to use this same composite video format. That's why domestic video connections were originally all made using the now-familiar single coaxial cables with an RCA plug at each end, usually with yellow colour coding.

Compromises, compromises

Although composite video signals can produce quite good picture quality, there are a few compromises involved in "packing" all of those video components into a single composite signal – and then subsequently processing them in this form. The big problem is that it's relatively easy for the various signals to interact with each other, in a way that actually degrades the ultimate picture quality.

Probably the most serious type of interaction that occurs is "cross modulation" between the luminance (Y) and chrominance (C) information. This can happen fairly easily with composite video, because of the way the chrominance information is conveyed as modulation on a separate colour subcarrier, which has a frequency of 4.433MHz for PAL video or 3.58MHz for NTSC. Although the colour subcarrier itself is suppressed in the video signal (and recreated in the receiver using the burst information), the actual colour information "sidebands" share some of the same frequency spectrum as the luminance information and are actually interleaved with it. This is shown in a slightly simplified form in Fig.1.

As you can see, the luminance and chrominance signals actually share the frequencies between about 3.2MHz and 5.5MHz. The magnified close-up view shows how the two sets of information exist in evenly spaced "clumps", with the colour clumps neatly slotting between the luminance clumps. This interleaving was done deliberately, in an effort to minimise the interaction between the two components.

However, it doesn't entirely prevent interaction, which is why you tend to see shimmering "cross-colour" bands on a picture area where there are finely spaced lines, such as a finely checked shirt.

This type of visible Y-C interaction was much more pronounced with early colour TV receivers, because they had to use fairly traditional analog filters to separate out the luminance (Y) and chrominance (C) information. The problem here was that the low-pass

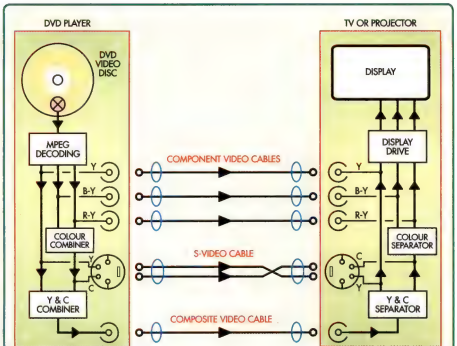


Fig.2: this diagram shows the different signal processing paths involved for component video, S-video and composite video. Component video has the least amount of processing (and the best picture quality), while composite video has the most processing (and the worst picture quality).

filter used to extract the Y information had to have a cutoff frequency no higher than about 3.2MHz, in order to filter out all the colour information.

Similarly, even if the high-pass or bandpass filter used to extract the C information had a lower cutoff frequency very close to 3.2MHz, there was still be quite a bit of Y information present in the chrominance signal.

By the way, notice that with this analog filtering method of Y-C separation, all luminance information above about 3.2MHz must be "thrown away", to avoid getting colour information mixed in with the luminance. So the picture resolution is degraded as well.

To get around this problem, later colour TV receivers (as well as recent monitors and video projectors) use a more sophisticated technique to separate out the Y and C information. This technique is known as "comb filtering" and it involves the use of digital techniques to produce filters which have responses shaped like combs – with "teeth" that can separate the two sets of information clumps. One filter extracts all of the Y information clumps, while the other extracts all of the C information clumps.

That way, the Y and C video information can be separated properly, without sacrificing the bandwidth of either. The result is clearer and sharper pictures, with a minimum of cross-colour interaction.

DVD recording format

Of course, the only way to completely ensure that there's no interaction between the luminance and chrominance is to keep them separate in the first place. And that's why when the standards were being developed for DVD video discs, it was decided that the video would actually be recorded in "separate component" format – with the Y information kept completely separate from the C information.

What's more, even the C information would be split into two separate components, to keep the colour "cleaner".

As you may know, both the video and audio are recorded on DVDs in digitally compressed form (MPEG-2), to allow everything to be squeezed into a maximum bit rate of 9.8Mb/s (megabits per second). But the video is still kept as three separated components, even when it's digitally compressed. So when a DVD is played back, the initial output from the player's MPEG decoder section is in component video form: the luminance (Y) signal plus two "colour difference" signals (B-Y and R-Y).

DVD player outputs

When the first DVD players came out, most TV sets were only provided with a composite video input (that's if they had a video input at all). So, to ensure that people would be able to watch DVDs on their existing sets, the manufacturers fitted their players with additional video processing circuitry, to combine the decoded component video signals into composite video.

That was fine but it meant that the video signals had to be passed through extra processing circuitry in the player to produce the composite video. It then had to go through a full Y/C separation and colour separation process in the TV set again, to produce the three component video signals needed for the TV set or projector to display the pictures. These steps are shown in Fig.2.

As you can see, this way of playing DVDs via the composite video path involves quite a bit of processing, not only in the player but in the TV set (or projector) as well. The component video signals have to be combined in the player and then separated again in the TV set or projector – all so we can connect the two pieces of equipment using a single video cable!

All of this extra video processing inevitably causes signal degradation. And because we deliberately force the various video components through a composite video "tunnel" (ie, the cable at the bottom of Fig.2), it also tends to introduce some Y-C interaction. That's a pity, because the signals actually coming off the DVD video disc already match the component video format that's ultimately required inside the TV set to display them.

This is also illustrated in Fig.2, which shows that much less processing is involved for component video signals. Obviously, it's far better not to combine the component video signals at all but to send them to directly to the TV or projector in their "native" form, to drive the display circuitry.

S-video input

The first big step forward was when TV and projector makers started providing their sets with S-video inputs, which could at least cope with separated luminance (Y) and chrominance (C). This had already started by the

time the first DVD players appeared, because S-VHS camcorder makers had got the ball rolling by fitting their products with S-video outputs. This was done so that consumers could take advantage of the improved picture quality possible with S-VHS.

By providing their first-generation DVD players with S-video outputs (as well as composite outputs), the DVD makers made it possible for consumers to take advantage of the better picture quality offered by DVDs. As you can see from Fig.2, an S-video link at least bypasses the Y/C combining circuitry in the DVD player, as well as the Y/C separation circuitry in the TV or projector. This removes two signal processing steps and also means that the Y and C components are never combined at all – not even briefly.

As a result, Y-C interaction is avoided completely.

Users soon found that S-video was well worth the extra hassle of having to use a different video cable. However, the picture quality would be even better again if the pristine component video that came direct from the DVD player's MPEG decoder could be piped directly to the display circuitry of the TV set or projector.

Of course, this couldn't be done until TV and projector makers started providing their sets with component video inputs. Once such sets began appearing, DVD players with component video outputs began appearing as well. As a result, consumers could finally feed fully separated component video signals from DVD players directly into their TVs and video projectors.

Get the idea? Although S-video and component video connections might seem to be more complicated and messier than composite video, they're actually less complicated for the video signals. That's because the components are kept separate and go through much less processing. And that means they're degraded less and so you get clearer pictures.

What about RGB?

Some TV sets of European origin are provided with inputs for component video in yet another format known as "RGB", where the three primary colour signals are already separated. This type of component video outputis also provided by some pay-TV and digital set-top boxes.

In theory. RGB should offer slightly better picture quality again than Y/B-Y/R-Y component video, because the display drive circuits in a TV or projector do ultimately need the video signals in this very form. However, in practice, the picture quality is often much the same, because even if your set has direct RGB inputs, the signals still have to be converted into this form (from Y/B-Y/R-Y) in the DVD player or set-top box.

The proof is in the picture

Perhaps you still don't quite believe that S-video and component video really deliver better picture quality. Well, the best way to be convinced is to compare them with your own eyes. But since you may not find it easy to do this, we've taken close-up shots of part of a standard test pattern image, as reproduced from a PAL DVD test disc on a video projector.

The first picture was obtained using a composite video link, the second using an S-video link and the third using component video links. These pictures will give you at least some idea of the improvements that can be achieved.

Notice in the composite video image that there are bright multi-coloured fringes in the circular "Fresnel Zone Plate" pattern at centre left. These all consist of "fake colour", caused by high-frequency Y information getting into the colour information (ie, cross-colour interaction).

There are also weak bands of fake colour in the two frequency band squares at top centre of this image.

As you can see, the luminance response does extend all the way to 5.5MHz, as shown by the tapering lines on the right of the image. This is presumably because the projector used to display these images uses comb filters to perform the Y/C separation from the composite video, so the upper luminance frequencies are not being "thrown away". Still, those fake colour artefacts do result in noticeable picture degradation.

If you compare the S-video and component video images with this first image, you'll see that there is much less colour fringing using the S-video signals and virtually none at all using component video. There's no doubt that the S-video link gives significantly clearer pictures than composite video, while component video gives the cleanest and sharpest pictures of all. SC

Fig.3: these three pictures clearly illustrate the improved picture quality delivered by S-video and component video signals. These's much less colour fringing using S-video compared to composite video, while component video gives the best picture of all.

VAF's new DC-X Gen

VAF Research released their original DC-X loudspeaker in 1997. It offered high sensitivity, smooth frequency and phase responses, and exceptional time domain performance. This was all delivered by a speaker with a very simple crossover network – just a capacitor to feed the tweeters. In this edited article Philip Vafiadis and Simon Wilde explain the design philosophy behind the latest version of the much improved DC-X Generation IV and present construction details for the new speaker kit. For more detail, the full unedited article can be found at www.vaf.com.au.

When a conventional speaker is fed with a signal, its drivers radiate sound into a room to be heard by a listener. But much more is happening in this transaction.

Energy is continually being stored and released by various resonances within the speaker system or between its key elements.

Consider a conventional speaker. Sound radiates from the front of the driver and is heard by the listener. Sound also radiates from the rear of the driver into the cabinet.

This rear energy is reflected off the internal surfaces of the cabinet back to the driver and some of it will be transmitted through the driver's cone to be heard by the listener a moment after the original sound. Further reflections inside the cabinet will occur until all the energy is dissipated.

This stored energy is released at many different moments in time after the original (direct) sound has projected from the drivers' diaphragms.

So in reality a conventional speaker system's output is a blend of direct and delayed signals.

A conventional crossover network can tailor the system's output but cannot significantly compensate for Stored Energy.

In the original VAF DC-X loudspeaker, the rear energy from the drivers was directed into a long tapered lossy transmission line to dissipate it, eliminating any need for compensation.

Emphasis on accuracy

VAF believes the purpose of a loudspeaker is to reproduce the signal it is supplied and not to add its own character in the process. This seems simple but what does it mean?

Even frequency response measurement is fraught with irrelevance or error.

It seems almost self-evident that a flat frequency response is ideal but again, what does this mean? Many speakers are measured only at one metre and on the tweeter's axis, whereas most listeners sit at around three to four metres from their speakers and may or may not be aligned to their tweeters' axes.

Furthermore, most speakers have two or more drivers spaced some distance apart on the front baffle. As a consequence, the response yielded at one measurement distance must be different to that measured at another point.

The content of all music and movies is very dynamic. Even a poor recording will have a dynamic range of at least 50dB. That's a power ratio of 100,000 from the quietest to the loudest passages.

The output of all loudspeakers will compress to some extent as their input power is increased. If the high frequencies compress at a different rate to the low frequencies then frequency responses measured at different input powers will also reflect this change.

Even just considering this on-axis frequency response we can see that it can be delivered in any number of ways to yield any number of outcomes.

Equally, there are many other measurements that can be used to characterise the performance of a speaker and equally these are subject to great interpretation.

The following factors, together with the internal cabinet reflections described above, are the fundamental set of issues that contribute to Stored Energy in loudspeakers.

Even speaker types like electrostatic, ribbon, piezo electric and wide-range horns are all subject to the following factors.

1: Diffraction Sound that radiates across the enclosure's front baffle diffracts off the driver edges, cabinet edges, nearby furniture etc. Conse-

SPECIFICATIONS

Nominal impedance:	8Ω (4.9Ω min; 14.2Ω max)
Sensitivity:	95dB/watt (2.83V)
Power rating:	10W to 200W
Frequency response:	35Hz-18kHz +/-2dB (-3db @ 32Hz)
Dimensions:	1195h x 250w x 350d (mm)
Weight:	32Kg each
THD:	0.31%

ration IV loudspeaker

Here's the full kit as you would receive it from VAF, including enclosure, drivers, crossovers and the all important foam pieces. (OK, it's half the kit – for one enclosure. Sorry!). Each of the items is detailed in the parts list.

quently, the diffracted sound will be delivered to the listener's ears at a succession of latter times than the direct sound.

2: Propagation through a driver's diaphragm At low frequencies, where the loudspeaker's cone is small with respect to the wavelength of sound being reproduced, it tends to act as a piston and behave as a point sound source.

At higher frequencies where the dimensions of the driver's diaphragm is large with respect to the wavelength of sound being reproduced, it will not act as a piston . While some energy will radiate forward into the air, some will propagate radially outward through the diaphragm to the roll surround which should effectively damp the energy.

3: Driver & Cabinet resonances All loudspeakers have resonances and this will cause them to deliver sound for some time after they are excited. Similarly, no speaker cabinet can be made infinitely rigid or perfectly damped.

4: Electrical damping Complex electrical crossovers can compromise the ability of the amplifier to provide electrical damping particularly if the inductors have significant resistance. The higher the electrical Q of the filter, the worse the problem will be.

5: Time alignment If the distance from a listening position to each of the drivers differs, the listener will receive the sound from each driver at different moments in time. This problem is compounded by the fact that most drivers do not radiate from just one fixed point at all the frequencies that they reproduce.

It is compounded again as some frequencies are the combined output of two or more drivers. The result of poor time alignment is poor overall impulse, transient and phase responses.

DISTORTION

Fundamental Frequency	THD (%)
60	0.48
120	0.34
240	0.31
480	0.31
960	0.25
1920	0.40
3840	0.25
7680	0.19

These very impressive THD specs show the linearity of the drivers and the design. Figures of less than 1% across the range are very unusual in speakers.

Solutions

VAF's Generation IV DC-X loudspeaker addresses these issues with the following aims:

- Flat Frequency Response target

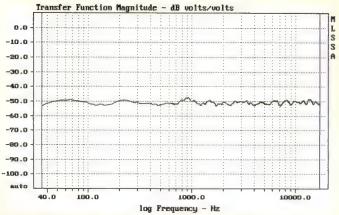


Fig 1: unsmoothed Frequency response 30Hz-20KHz. Although not shown here it is worthy of note that the flatness of this response is maintained over almost all of the frequency range at sound pressure levels as high as 110dB!

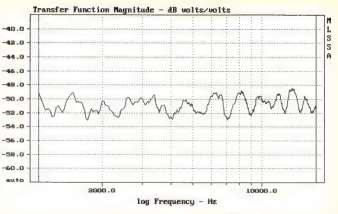


Fig 2: here is an extreme close up of the unsmoothed Frequency response. This type of unsmoothed raw data is almost never published. While a remarkable +/-2dB is achieved, under the more common 1/3 octave smoothing this plot would resemble a straight line!

of ±2dB over most of the frequency range.

• Flat Phase Response of better than ±50° over most frequencies above bass resonance, and almost flat phase through the critical mid range (Fig 3). Speakers with excellent phase performance create a more tangible three dimensional sonic representation, ie, it sounds more real.

• Deep Bass: To avoid the need for a subwoofer in Surround Sound Theatre systems, low distortion bass down to 30Hz and audible output to around 25Hz was the aim. The new DC-X produces cleaner and more powerful bass than many dedicated subwoofers.

• High efficiency and 110dB dynamic range with low compression. Many Surround Sound receivers will not drive all channels to rated capacity simultaneously. So target efficiency was 95dB SPL at 1 one meter

• Low Distortion: Less than 1% at most frequencies at up to 100dB. As well as using low distortion drivers each woofer is in its own separate enclosure which is proportioned differently to yield differing impedance responses. This reduces cabinet related distortion levels significantly.

• Wide Power Response (a measure of the total output of a speaker in all directions). In the new DC-X two tweeters are aimed in slightly different directions to broaden the high frequency dispersion.

Both tweeters are time aligned with the woofers so there are minimal off-axis response lobes and almost double the off-axis energy of the original DC-X above 5kHz.

• Minimum stored energy. Characterised by the cumulative spectral decay measurement. The New DC-X uses many mechanisms to minimise stored energy including the extreme efforts made to control diffraction around the tweeters.

Meeting the challenge

You can see from the accompanying Step Function (Fig.7), Impulse Response (Fig.8), Phase Response (Fig.9), Cumulative Spectral Decay (Fig.6) and Distortion Measurements that the new DC-X loudspeakers are very accurate indeed. The new model DC-X is basically a product of the following building blocks.

Woofers: Each enclosure uses two 210mm woofers with Composite Black Soft Kevlar cones. They feature T-shaped pole pieces and large, high temperature voice coils.

The voice coil and spider are both is vented to provide dramatically improved voice coil cooling which significantly reduces thermally related compression.

This venting facilitates exceptional dynamic linearity as does the linear excursion of 9.5mm and a total excursion of over 22mm. The Kevlar cones are fitted with a number of proprietary pads which provide further damping of propagation of sound through the cone itself which cone is terminated in

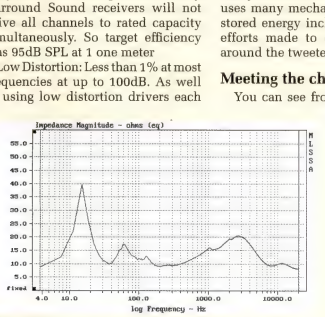


Fig 3: impedance response lower bass driver and tweeters.

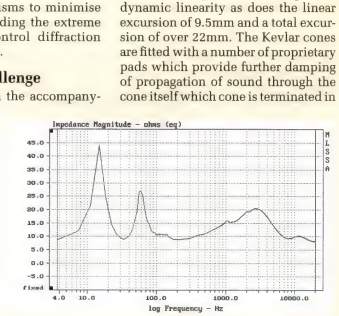


Fig 4: impedance response upper bass driver and tweeters.

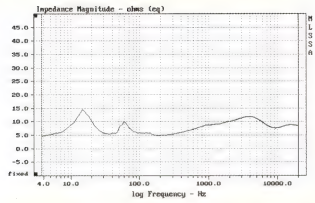


Fig 5: combined impedance of bass drivers and tweeters. Note that the impedance peaks around bass resonance are now effectively controlled ensuring greater power delivery from almost any amplifier that drives them. Also note how the minor variations in the individual woofer responses have been damped

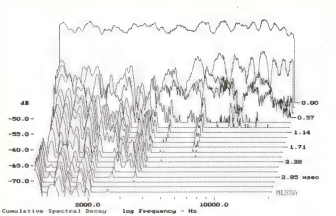


Fig 6. Cumulative Spectral Decay, unsmoothed, unfiltered. Note the very rapid early decay being around 15dB down in under 0.2mS!

a very compliant high loss soft rubber surround.

Tweeters: The 25mm dome tweeters have ferro-fluid damping, rare-earth magnets and heatsinks for overall cooling. A shallow horn is fitted in front of the dome, shaped to provide a flat overall response.

Cabinet: This has numerous internal angled surfaces and the geometry is such that the location of the woofers, ports and cabinet boundaries minimise transmission line effects.

Carefully positioned pieces of VAF Hypersoft III foam are used to attenuate rear radiation from the woofers. Each woofer in its separate enclosure is electrically connected in parallel. The small amount of energy returning to each woofer from the cabinet is damped through the other's voice coil. This more than halves cabinet-related distortions and is critical to the DC-X system's operation as an accurate low distortion transducer.

Crossover: The DC-X electronic components consist of high quality 5% tolerance metallised polypropylene capacitors, close tolerance high power non inductive resistors and 1% tolerance resin bound air cored inductors. The combined DC resistance of all wire and components in series with the woofers is negligible, to ensure providing maximum ideal electrical damping from the amplifier.

"The sound quality is quite exceptional, with very smooth and wide treble dispersion and extended bass. Combine that with very high efficiency (for a wide range speaker) and you have a pair of remarkable speakers."
(Leo Simpson)

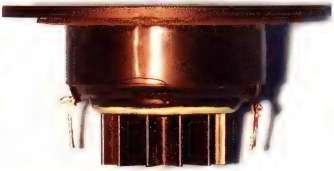
The speaker kits. . .

DC-X GEN-IV kits are only available directly from VAF Research and are provided with all parts required to complete their construction. A three year guarantee is standard on all VAF speakers even when bought as kits.

The cabinets supplied are finished with a high quality two-pack satin lacquer over the timber veneer.

Various options are available from a build-it-yourself flatpack, through pre-built enclosures and, if you don't have the time nor inclination to do it yourself, completely finished enclo-

The VAF W200FR1 composite Kevlar woofer has unique venting behind the suspension and venting through the top of the voice coil. The two venting techniques provide more air flow around the coil, therefore better heat dissipation.



The VAF T25DTH1 tweeter utilises a Neodymium magnet with a heat sink to make this a very low compression/high power handling driver.

Fig 6. Note the unusual horizontal offset of the tweeters to increase dispersion and complex acoustic treatment to control diffraction.

sures ready to plug in and enjoy.

A kit without any enclosures is also available for those who wish to build their own from scratch.

For constructors who intend using the DC-X loudspeakers in a home theatre system, VAF offers a range of centre channel and rear channel speakers with similar features to the DC-X. Contact VAF for details.

Parts List – VAF DC-X Generation IV Speakers

2 fully assembled and pre-finished veneered MDF speaker enclosures, (or build your own)
4 VAF W200FR1 200mm woofers
4VAF T25DTH1 dome tweeters
2 bi-wire gold-plated terminal panels with wiring looms and circuitry attached
20 pieces Hypersoft III foam (two parts A,B,E & G and four parts C, D and F)
4 male/femal grille clips
2 pieces 300 x 1200mm grille cloth
1 5m length cloth fastening spline
10- pieces felt (four each of parts A&B; two part C)
1 0.5m length closed-cell foam tape (to airtighten tweeters)
40 pan-head screws (driver mounting)
8 countersunk-head screws (terminal mounting)
4 20mm pan-head screws (electronics mounting)
1 tube glue
2 self-adhesive VAF badges

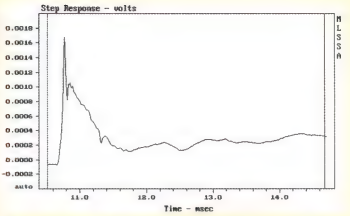


Fig 7. The near perfect Step function, again unfiltered. Only time aligned, phase coherent speakers are able to produce a step function like this.

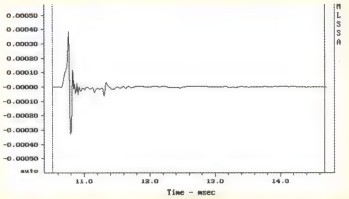


Fig 8. The Impulse response of the DC-X clearly shows the absence of ongoing 'ringing'.

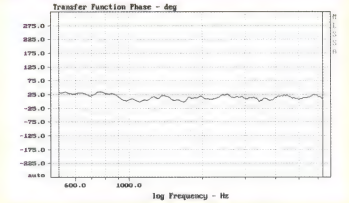


Fig 9. Actual measured phase response in the critical midrange area 500Hz to 7KHz.

Where from; how much . . .

The VAF DC-X Generation IV speakers are only available from VAF Research (see below) Three different options are available:

(1) No enclosures; speaker drivers and all other components only – $1149 pair
(2) As described above with pre-built enclosures and all other components – $1999 pair
(3) Fully built, assembled and tested enclosures, ready to use – $2499 pair

All prices included GST. Freight on any option is $80 per pair.
An eight-piece adjustable floor spike set is available for $45.00.
Contact VAF Research at 52-54 North Terrace, Kent Town, SA 5067. FreeCall 1800 818 882 or fax (08) 8363 9997;

VAF DC-X Generation IV Assembly procedure

(1) With the cabinet lying on its front, fit the two Hypersoft III foam part Ds through the rear port hole. Carefully squeeze the foam pieces through this hole so that they will be positioned as in the supplied assembly drawing. Position both pieces to the side of the cabinet. Find part E, with a sharp knife, cut this piece into two sections one 330mm long, the other 250mm long. Put these aside, as you will need them right after the next step.

(2) Fit the circuit board and the terminal housing. Place the cabinet on its side, with the front facing away from you. Place the circuit board through the square cutout in the rear of the cabinet. Secure it in place with the supplied screws. Feed the cables through the cabinet to the driver holes in the front. The cables for the lower bass driver and the tweeters will have to be inserted through the holes provided through the internal bracing and baffles to reach their respective drivers. You will have to tightly wrap the labels around the cable for the tweeter and lower bass driver to fit through the holes in the separating internal baffles.

Allow around 100mm of wire to protrude through the baffle to allow easy soldering to the drivers. The internal wire access holes do not need to be sealed and this will not affect the performance of the cabinet in any way. The wires to the drivers should now be positioned in a way that leaves no tangles and with each wire able to reach its appropriate driver. (Note: All wire ends are labelled, but please take particular care not to mix up the wires going to the woofers and tweeter. Now you can use those two pieces of part E that were previously cut. Place the 250mm piece between the terminal housing and the rear port on the rear of the cabinet. Place the 330mm piece above the port hole leading up to the top of the cabinet.

(3) Place the cabinet face-down. Watch that the wires coming out of the front of the cabinet are safely inside so they do not damage the front of the cabinet when you roll it over. Place the terminal housing into the rebated square hole and using the holes in the terminal as a guide, drill four 1.5mm diameter pilot holes for the mounting screws. Use four countersunk screws (supplied in sealed bag) to secure the terminal housing. Do not over-tighten the screws; enough pressure to compress the gasket behind the housing is sufficient. Next, the rear vent can be inserted into the cabinet. Push it in with the palm of your hand to set it flush with the cabinet.

Terminal housing ready to be screwed into cabinet.

Cable access through internal baffles.

(4) Place the cabinet on its back so that the rest of the damping can be fitted. Follow the DC X GEN-IV Foam Placement Guide precisely. The performance will suffer if the internal damping is not fitted exactly to plan. The foam is very resilient and will not be damaged through fitting and removing it several times to get it just right.

(5) Fit the second vent tube.

(6) Mount the drivers. The bass drivers have a soft sealing gasket but the tweeters require a separate sealing gasket. Apply the foam tape to the tweeter cutout holes as close to the inside edge of the hole as possible.

Rear port and terminal housing in place.

Woofer with labelled cable soldered onto terminals ready to be fitted into cabinet.

Hammer in grille clips using the female clip to protect the other clip.

Solder the wires to the bass drivers, making sure that the positive wire is connected to the terminal marked with the '+'. Double-check to make sure these wires are connected as marked, while no damage will result if the polarity is reversed, the sound of the loudspeaker will suffer. Apply a small amount of solder to the driver terminals, enough to cover one side of the terminal.

Hold the tinned wire end on the terminal and apply heat to the wire as it touches the terminal. The solder on the wire will melt and incorporate into the solder on the terminal, fusing the two together. Do not apply excessive heat to the wire and terminal. The drivers can now be screwed into place using Pan-head screws. Align the pre-drilled holes with the holes in the baskets of the drivers.

Speaker drivers in place (front vent tube not in photo).

(7) The DC-X uses specialised felt treatments around the tweeter. This is an integral part of the design and must be placed carefully. Using the DCX Felt Placement Guide, fit felt kits A, B and C. A total of six separate pieces are fitted to each cabinet. A tube of glue is supplied to hold the felt in place. Do not glue the felt parts C that go over the tweeters to the cabinet.

(8) The grille cloth frame can now be covered and the clips inserted. Follow the grille covering section for the best way to cover the grilles. After the cloth is attached, the male clips can be inserted into the frames. Using the female part of the clip as a protector, tap the male clip into the holes in the frame. The flange on the clip will finish flush with the frame.

After putting in all eight male clips into the grille frame you can now insert the female clips into the cabinet. Insert the clip into the hole and then gently tap it into the cabinet with a hammer.

(9) Fit the self-adhesive VAF badge around the apex at the bottom of the grille. About 10mm above the bottom edge of the grille.

(10) Repeat all of the above for the second speaker. Stand them up and connect to your amplifier. As with any new project, we recommend that you use your speakers for the first time at a low volume initially to confirm their correct operation.

(11) When you have confirmed that all is well, put on your favourite music (or movie), turn up the volume, sit back and be amazed. **SC**

One down, one to go. . .

NEW DUE MID AUGUST

KAMBROOK
Handy Lamp

60W light with two 240V electrical mains outlets, overload protection, 7m extension lead, and a portable design. Suitable for the workshop or the outdoors. M 7350

$28.67

NEW

KERIO

70W Universal AC adaptor

Universal PC power supply. Compact design, built-in circuit protection, with a maximum current output of 3.7A. M 9698

$148

NEW

2-Pin Male/Female DC Auto Lead

2-Pin Bullet style male/female lead suitable for low voltage DC wiring i.e. 12V DC 5A. P 2513

$1.94

NEW

Auto/Boat Socket Relay

Relay Base for Auto/Boat relays, plug in base with cable attached, suits (P 8035) relay. P 8036

$1.94

Auto/Boat SPDT 12V DC 30A Relay

Ideal for car/boat horn circuits, alarms, ignition cut-outs or any application where high currents have to be switched. P 8035

$2.98

NEW

Ultraviolet 5mm LED

High brightness LED with 70mcd luminous intensity. Z 3850

$3.98

NEW

Gold Banana Plugs

Gold plated metal banana plugs designed for monster type speaker cable. Supplied in a pack of 2 pcs - 1x red and 1x black. P 1746

$6.98

NEW

PIC16F628A-I/P Microcontroller

18-pin through hole design and features Flash program memory, RAM data memory, EEPROM data memory, 16 I/O pins. Z 9180

$7.36

NEW

Friedland Sesame Bell Switch

White door bell push button switch, rated 1-24V 2A, made in England. P 7557

$7.76

NEW

Friedland Lightspot Switch

Black door bell push button switch with illuminated button, rated 8V 2A, made in England. P 7565

$9.76

NEW

500mA 24V AC Adaptor

AC power adaptor with fly leads and a voltage of 12 volts AC. M 9818

$19.98

NEW

DSE

12V Battery Tester

Ideal for testing car batteries, onboard chargers and alternator/regulator output, convenient magnetic strip. Light weight and compact. Easy-to-read LED indicators. Q 1457

$14.96

Look what's NEW!

DICK SMITH ELECTRONICS

NEW

DSE

3.6V Cordless Screwdriver
Cordless rechargeable screwdriver with adjustable angle - straight or pistol grip. Supplied with chrome vanadium CRV bits, includes battery charger. T 4831

$12.98

NEW

PRO-IRODA PT-200 Butane Torch
Waterproof piezo electronic ignition system, up to 60mins use on each filling. Powerful wind-resistant flame, easily refilled with any brand of butane gas. T 1101

$49.94

NEW

PRO-IRODA PRO-70 70W Cordless Soldering Iron
Cordless, simple, and safe to operate. Ready to use 20 seconds after ignition, tank contains fuel for 120mins of operation, comes with soldering tip and protective cap. T 1104

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DSE

Photo Coating Spray 400g
Print and photo protectant spray for laser prints, inkjet prints, photographs, CD/DVD labels, scrapbooking, etc. Non-yellowing and acid free. N 1099

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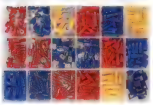
PROTECT YOUR PHOTOS!

NEW



DSE

389 Piece Terminal Kit
Includes an 18 compartment plastic box, ring terminals, butt splices, male and female tab connectors, bullet connectors, and 7 blue wire tab joiners. H 5063

$29.84

NEW

X-10 Hawkeye Motion Sensor
Tiny wireless motion sensor that can be attached to the wall with screws or self-adhesive strips. Activated by lighting sequences when detecting movement; a built-in photocell ensures that it operates only when it is dark. 30m range and adjustable time delay of 1 to 256mins. M 4016

$49.96

NEW

DSE

NETWORK Cable Tester
Identify cable faults such as incorrect connection, open, short, crossover and grounding test. Suits network UTP, STP, 10BASE-T, Token Ring, AT & T258, EIA/TIA568, USOC, 8P8C, 6P6C, 4P4C, BNC and TNC. Also tests a wide variety of standard cables. Q 1523

$64.87

NEW

DSE

LAN Cable Tester
Identify cable faults such as incorrect connection, open, short, crossover and grounding test. Suits network UTP, STP, 10BASE-T, Token Ring, AT & T258, EIA/TIA568, USOC, 8P8C, 6P6C, 4P4C, BNC and TNC. Can test located and remote cables and various types of network and needlework connecting wires. Q 1503

$77.64

NEW

X-10 Wireless Wall Switch
Add wall switches all over your home, without the need for extra wiring. Requires a 3V lithium battery. Compatible with the full range of X-10 home automation products. M 4017

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RFID Security Module Kit
Requires no physical contact and no batteries. Based on Radio Frequency Identity technology.
K 7215

$69.82

SILICON CHIP Jun '04

Fridge Door-Open Alarm Kit
Operates by detecting when any light enters the compartment area. The Alarm will sound if the light is present for longer than the preset period.
K 7216

$12.96

SILICON CHIP Jun '04

Energy Meter Kit
Displays power in Watts, energy usage in kWh, measurement period in hours, energy cost in dollars and cents.
K 7217

$127

SILICON CHIP Jul '04

Scarab Robot Kit
Educational electronic robot kit that makes use of 2 touch sensors to detect obstacles. Comes complete with 2 sets of differently designed legs, providing endless fun. Tools required: 4 x AA batteries, soldering iron, solder, long nose pliers, diagonal cutter, screwdriver (not supplied). K 1231

Due mid August 2004

$29.97

Ladybug Robot Kit
This educational electronic robot kit moves with its 6 legs and makes use of infrared emitting diodes as its eyes to avoid obstacles along its path. Tools required: 4 x AA batteries, soldering iron, solder, long nose pliers, diagonal cutter, screwdriver (not supplied).
K 1232

Due mid August 2004

$22.92

Escape Robot Kit
Never fails to find its way out of a maze. An in-built microprocessor enables it to think on its own, as it processes information about its environment and manoeuvres itself around obstacles. Tools required: 4 x AA batteries, soldering iron, solder, long nose pliers, diagonal cutter, screwdriver (not supplied).
K 1233

Due mid August 2004

$29.97

Micro Battery Protection Kit
Protect expensive batteries with this mini-sized, micro-powered electronic cut-out switch. Ultra-low power consumption (<20uA), 10A maximum rating, suitable for use with 4.8V – 12.5V batteries.
K 3132

SILICON CHIP Jul '04

$34.67

Weather Satellite Receiver Kit
2 channel VHF FM receiver dedicated to picking up weather satellite signals in the 137 – 138MHz band. Supplied with all specified components, PCB, case and panels.
K 3226

$89.88

SILICON CHIP Dec '03

Level Meter Kit
Perfect for precisely adjusting speaker levels when setting up a home theatre system, with built-in microphone and bargraph display. Supplied with PCB and all necessary components.
K 5624

$29.87

SILICON CHIP Apr '04

Shorted Turns Test Kit
In-circuit testing, ideal for TV/monitor servicing. Complete with all parts (except 4 x AAA batteries).
K 7205

$49.80

SILICON CHIP Feb '04

ESR Meter Mk 2 Kit
Easily identify defective electrolytic capacitors. Allows in-circuit testing, features auto-ranging covering 0.01 – 99 ohms, non-polarised test leads, test lead resistance zeroing. K 7214

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SILICON CHIP Apr '04

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Features high brightness with cool white light, low battery drain and a torch bulb that never needs replacement. Supplied with all components, white LED, PCB and mini torch. K 3018

EVERYDAY ZIP Dec '00

$9.94 LOW PRICE

Digital Multimeter Kit
Features a 3.5 digit display. Supplied with all components, hardware, PCB, plastic case, LCD display, 9 volt battery and test leads. Measures voltage AC/DC, DC current to 10A, resistance 200k to 2000k. K 1044

EVERYDAY ZIP Jun '95

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CLEARANCE

HOT CHIP **Starter Pack**
Includes the Hot Chip microcontroller (Atmel RISC chip) with 8MHz clock speed, serial cable, parallel cable, extensive software (Development System, Basic Compiler and Assembler), and on-line help. K 1430

LIMITED STOCK

$59.97 SAVE $40

PSU 0-40V 3A Max Kit
Dual rail benchtop supply. Variable output: 0V–40V (20V–0–20V). Output current: up to 3.5A, current drops below 3A above 20V. Features both voltage and current meters and electrical and thermal overload protection. Power source required: 240V AC. Supplied with components, hardware, PCB, panel meters, case and pre-punched, pre-screened front panel. K 3206

EA Jan '94

$128 SAVE $70

Solar Generator Kit
This is a cheap, no fuss way to trickle charge a 12V lead acid or gell cell battery using a solar panel. Ideal for any area where mains power is unavailable. K 3129

ETI Dec '87

$9.85 SAVE $7

Low Battery Cut-Out Kit
Ideal for car or boat when powering external accessories. Disconnects the load from the battery once the voltage drops to a pre-determined level. Adjustable drop-out voltage: 10.9V–11.9V (nominal). Can be set to automatically restore power to the load when the battery returns to normal condition. Supplied with components, hardware, PCB, case and front panel label. Power source required: 12V DC. K 3124

EA Jan '92

$19.88 SAVE $10

Battery Charger Regulator Kit
Turns a 'bare bones' 12V automotive battery charger into a fully regulated charger. Designed to adapt an Arlec 4 charger or similar unit. Supplied with components, PCB and heatsink bracket. Case optional (use charger case). K 3127

EA Jul '97

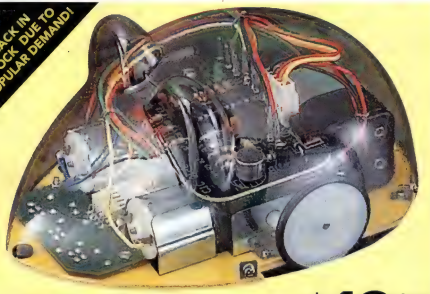
$18.80 SAVE $10

Battery Controller Kit
This dual battery manager controls when and how the 'auxiliary' battery is connected to the car's electrical system. The kit is supplied with all components, hardware, PCB, diecast box and front-panel label. K 3212

EA Jan '96

$29.97 LOW PRICE

BACK IN STOCK DUE TO POPULAR DEMAND!



Line Tracking Mouse Kit
This intelligent robotic mouse tracks a black line using three photo interrupters for its eyes. Includes a programmed IC and is sound activated. Power source required : 4 x AA batteries (not included). K 1235

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The electronics

WBU-204+J Breadboard Kit
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Dot Matrix Screens
Module Size: 80(W) x 36(H) x 10(D)mm.
Effective Display Area: 64.0(W) x 17.2(H)mm.
Microprocessor compatible 4-bit and 8-bit data bus.

Dot Matrix 16 Character x 2 Lines Module
Z 4170

$19.96

Backlit Dot Matrix 16 Character x 2 Lines Module
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57mm Mini Speaker
Ideal for small radios and a wide range of kits. Maximum Power: 0.25W Impedance: 8 Ohms.
C 2222

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LOW PRICE

Zinc-Plated Assorted Pack
Includes M3.0 10 x 6, 9, 12, 25mm bolts, 40 x nuts and 40 x flat, shakeproof and spring washers. (200 pcs.)
H 1687

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SAVE $5

Aluminium Sheet
Blank aluminium sheet ideal for making front panels, folding into small boxes. 18 gauge and measures 300 x 300mm.
H 2560

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SAVE $5

Digital pH Meter
Measure water pH in swimming pools, spas and aquariums. Supplied in a carry case with pH7 buffer solution.
Q 1416

$66
SAVE $33

LED 10mm Round Big RED 33mcd
2.0V typical, 3.0V max. 20mA.
Z 4060

44¢
SAVE 14¢

Wire Hookup 12 Colour Pack
Pack of 12 x 2m of different coloured strands of light duty wire. W 4010

$2.98
SAVE $3.25

AMPHENOL CONNECTORS

XLR 3 Pole Metal Panel Plug
Rugged construction, compatible with all other Amphenol (Cannon) XLR range.
P 1622

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XLR 3 Pole Plastic Panel Socket
With a positive latch lock system, this is a lower-cost alternative to the metal-shell series of panel latches.
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$2.98
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XLR 3 Pole Metal Panel Socket
Socket, 3-pin, metal with latch.
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KT Missile Toggle Switch SPST
On/Off metal toggle switch.
P 7691

$9.96
LOW PRICE

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Audio connector that maintains complete insulation where RFI shielding is not a prerequisite.
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XLR 3 Pole Metal Line Plug
Metal shell with plastic base. P 1623

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Can be used in audio/video and other low level circuit applications.
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XLR 3 Pole Plastic Line Plug
Low cost audio connector manufactured from glass filled resin.
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Provides proven user benefits such as minimised assembly operator training times, plus the surety of a perfect connection. P 1608

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This audio connector is the world's first solderless connector of its type. P 1607

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Integrated 8 x 21 binoculars and 640 x 480 resolution digital camera.

L 8230 *LIMITED STOCK

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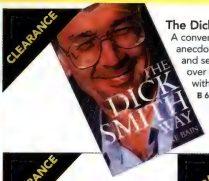

The Dick Smith Way

A conversational narrative of anecdotes, tips, practical advice and secrets of success learnt from over twenty-five years of working with Dick Smith.

B 6180

$9.93

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CLEARANCE

Windows ME for Dummies

Discover how to handle Windows ME basics. Have fun with audio, video and images. B 6558

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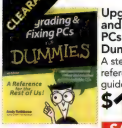

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A step by step reference guide. B 6657

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6.3 – 15V @ 2A

Dimensions: 60 x 70 x 68mm. Terminations: Solder lugs.

M 2156

$7.94

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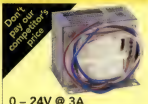

0 – 24V @ 3A

Dimensions: 76(L) x 41(W) x 64mm(H). Terminations: Flying leads.

M 2158

$7.94

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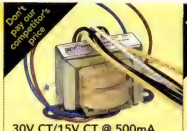

30V CT/15V CT @ 500mA

Dimensions: 50(L) x 61(W) x 45mm(H). Terminations: Solder lugs.

M 2860

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12 – 30V @ 2A

Dimensions: 66 x 79 x 69mm. Terminations: Solder lugs.

M 1991

$9.94

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6.3-15V @ 1A

Dimensions: 50 x 61 x 53mm. Terminations: Solder lugs.

M 2155

$9.98

Don't pay our competitor's price

12.6V CT @ 3.6VA

Dimensions: 65 x 22.5 x 36mm. Terminations: Flying leads.

M 2853

$4.98

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18V @ 6A

*SPECIAL ORDER ONLY

Dimensions: 80 x 96 x 74mm. Terminations: Flying leads.

M 2000

$24.92*

CLEARANCE

74C926 4 Digit/Driver Counter

A CMOS Counter consisting of a 4-decade counter, an internal output latch, NPN output sourcing drivers for a 7-segment display and an internal multiplexing circuit with four multiplexing outputs. Z 5414

$9.01

SAVE $3.92

CLEARANCE

ProMeasure Ultrasonic Tape Measure

Uses ultrasonic technology for quick measurements of distance, area and volume measurement range from 60cm to 15m. Q 1413

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CLEARANCE

Weller Assorted Cable Ties 350Pk

H 2024

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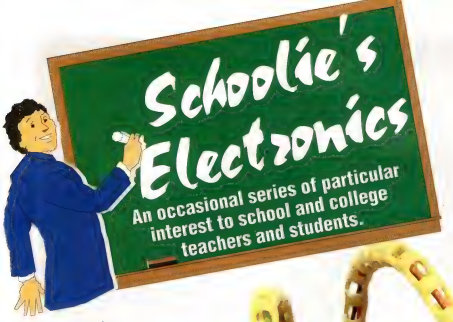
DICK SMITH ELECTRONICS

81303



Students, teachers and grown up kids of all ages have been hanging out for a kit such as this for years: a piece of great design and good engineering, together with a low cost can do the unthinkable... bring FUN back into the classroom!

This month: a kit review by Dave Kennedy*

ESCAPE ROBOT KIT

It's called an Escape Robot and it does exactly that: manoeuvres around obstacles, weaves its way through mazes and ultimately escapes from entrapment. It can also move, in a seemingly clever way, around and across perimeters, closely exhibiting insect intelligence.

Overall, we were very impressed with the package.

The completed robot with his see-through dome cover and battery packs removed so you can see the "works". We added the extra cell so we could use NiCads or NiMH batteries.

How it works

The Robot transmits infrared pulses from three points in its front field of view. Reflected pulses are received by a receiver module and the data is processed onboard.

Evasive action is then directed to the drive motors with a clever gear-box configuration delivering output to three axles on either side of the robot. It also communicates its intentions with audible beeps.

The robot has interchangeable cup wheels or individual leg attachments, enabling a variety of movement styles. The body is encapsulated in a clear bubble and the whole package looks incredibly realistic, in a robotic sense.

The robot measures a very credible (for a robot!) 150 x 150 x 120mm.

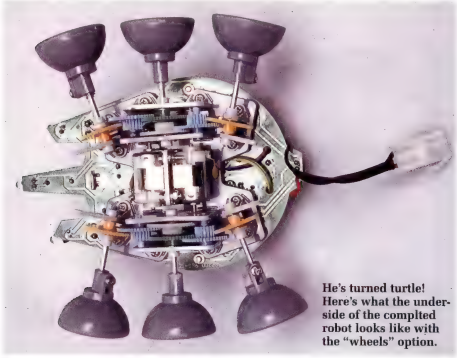
The power supply is 6V via four AAA cells (comments later).

Kit quality

All of the electronic, mechanical and structural part counts were correct. The electronic parts are of a good quality and the PC board is robust, stencilled and part placements are roomy. The tracks were tested to 370°C without lifting (kids love to cook PC boards). The addition of an IC socket and LED mounting brackets is thoughtful.

The structural sections are of the press-out, pre-moulded type and their tolerances in construction are excellent.

The motors, gears and axles mount well and include brass bushes. The main base plate has small support ridges on it, which make it easy to orient and stabilise the support panels, and mounts, while you screw them into place.



He's turned turtle! Here's what the underside of the complted robot looks like with the "wheels" option.

Compared to some of the "educational" kits we've often been forced to use, this really is a quality kit.

At this stage the spare parts situation is unclear but (apart from the PIC) you should be able to obtain most of the electronic parts from the usual sources, including the kit supplier.

Tools required

Constructors will need access to a fine tipped temperature controlled soldering iron set to 320°C (something that's not always readily available in schools) and flux core solder under 1mm. For close-up soldering, safety goggles are required. Miniature diagonal nippers and long-nosed pliers are also "a must". A Philips #2 driver is needed and it is helpful if it is magnetised. A multimeter is handy for troubleshooting, of course.

Kit instructions.

There are two sets of instructions, one for the electronics module and one for the mechanical construction. Both are of the pictorial kind, using very few written prompts. This is an increasing trend in international kit production and emphasises the increased role of the decreasingly paid technology teachers in our schools. (Stop whinging Dave, Ed.)

The pictorials are actually quite good, if you look at them closely, and teachers constructing the kit will be able to make mental notes of the fine implied instructions **before** the kits are given to students.

Some of the mechanical instructions need strong scrutiny, especially

The completed project, disassembled enough so that you can identify the major components/assemblies. Top of the picture is the modified power supply (see next page); centre is the gearbox/wheel assembly and at the bottom is the main PC board with all the electronics. A clear dome covers the finished robot.

the motor housing and gear assembly tasks.

The best teaching strategy is to remove the instructions from the kits. That's right, ***don't give the instructions to the kids***! If you do, some of the idiots (woops, delightful students) will run blindly ahead and completely mess up their kits.

Instead copy only the part identification pictorials and give them these sections. You can then go through the parts check list and identification skills prior to construction.

One great aspect of this kit is the fact that the electronic part number is displayed on the PC board but the part value is not. This means that you can run the part selection and insertion process in class, literally part for part.

Here's a tip (from experience!): enlarge the electronic and mechanical construction instructions onto overhead transparencies or A4 paper sheets, using a new overhead or sheet for each step. In this way you will keep the whole class at the same construction sequence and you can control each step of the process.

If you have gifted kids who work quicker than the pack, let them act your special helpers or "apprentices" and get them to help the other kids to catch up.

Leg and wheel configurations

When you construct the robot, the last step is to attach the legs and /or wheels. While the legs produce a very bug-like movement, fitting them permanently is not a good idea.

They end up going out of synchronisation under load and the gearboxes may get tooth-stripped. In addition, much more current is consumed.

The cup wheels are the better option. The axles are offset at different angles to the body of the kit and they produce a surprising grip as a result. The robot moves in a seemingly sliding way on a variety of surfaces.

Student skills

This kit is not suitable for novices, nor is it a suitable project for under-equipped classroom use.

Students completing this kit must be already well trained in fine-detail soldering, part identification, construction skills and basic electronics theory.

As a guide, my students have completed a basic electronics course at the year eight level for 30 hours. In year nine they undergo a further 30 hours of mainly practical work, before I'll give them a go at this kit. It also depends on your class size and the ability level of the kids.

The bad news

The bad news is that the robot draws 300mA at idle conditions and 600mA and more under physical load. This means that AAA dry cells are almost literally eaten by this kit.

Don't give up though, there are solutions to this problem.

A simple solution

Get the kids to buy Nicad or even 800mA NiMH (Nickel-Metal- Hydride) AAA batteries. As these rechargeables are rated at 1.2V, it is necessary to add one more battery to the pack in the robot to provide the required 6V.

A single battery is easily added beside the 4-pack within the bubble housing.

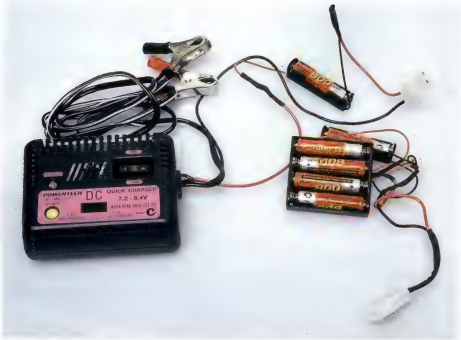
The extra battery must be connected into the negative side of the wiring before it enters the connecting plug on the PC board. Simply cut the black supply lead and splice in the extra battery. (See Fig.1)

A better solution

Buy a cheap car battery and a cheap trickle charger for the classroom/lab. (You can use these as a power supply for other kits as well.) Also buy a 12v to 7.2V fast charger (around $40; eg Powertech 12V-7.2V @ 1.5A). Just be careful with battery acid – it can be pretty nasty stuff.

A further Nicad is needed in series with the charging circuit to bring it up to the required 7.2V loading for the fast charger.

This "dummy" battery is connected



Compare this photo to the diagram below when modifying the power supply to use NiCads or NiMH cells. If you don't do this, the kids will always be buying batteries because the robot really chews through them . . .

WHERE FROM, HOW MUCH?

The Escape Robot kit is available from Altronics stores (Perth, Sydney and Mail Order) for $39.95 rrp (Cat K1103)
They also have AAA NiMh cells for $9.95 pk 2, (Cat S4742B); single AAA cell holders for 55c each (Cat S5051).

The Powertech 7.2V/1.5A Quick Charger is from Jaycar; selling for $39.95 (Cat MB-3515).

outside the robot. Charging leads can then be taken out of the bubble at the rear of the robot and fashioned into a "tail."

Fig.1 shows the complete wiring harness.

Tech talk

The power supply is tapped at 4.5v for the motors. The logic runs at 3.6v via a zener on the 6V rail. This ensures that the logic will not fail as the motors run the batteries down. The heart of the circuit is a 78P156ID PIC which is crystal clocked at 4MHz. The IR LEDs and the buzzer are switched by NPN signal transistors that are driven by PIC outputs.

A single IR receiver unit sends data pulses directly to the PIC. The motors are driven by NPN and PNP signal transistors configured in the standard H pattern on either polarities of the drive motors. They are triggered by PIC outputs. There is no listing for the PIC's software, so this can't readily be used for any programming teaching.

Costings

If you haven't done so already, register your school as a wholesale customer at all of the major suppliers that you deal with. Your costs will be cut by up to 30%!

Good luck in construction and have heaps of fun with maze competitions and drag races!

Oh, sorry, I meant help the students have heaps of fun . . .

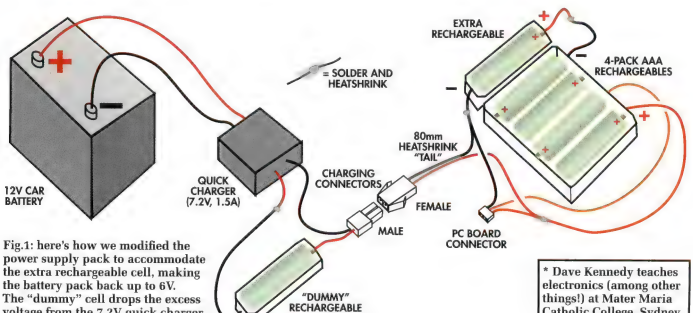


Fig.1: here's how we modified the power supply pack to accommodate the extra rechargeable cell, making the battery pack back up to 6V. The "dummy" cell drops the excess voltage from the 7.2V quick charger.

* Dave Kennedy teaches electronics (among other things!) at Mater Maria Catholic College, Sydney.

Video Enhancer & Y/C Separator

- S-video from your VCR
- Adaptive digital comb filtering
- Edge enhancement

by JIM ROWE

Are you planning to transfer some of your VHS videotapes over to DVD, via your computer? If so, you need this project. It's not only an edge enhancer to sharpen up the picture but also a Y/C separator, which converts the composite video from your VCR into S-video so you get a higher quality transfer.

THE VIDEO SIGNALS from an analog VCR are not only in composite video form but are also fairly limited in luminance (Y) bandwidth, due to the limitations of VHS recording. In fact, the luminance bandwidth is typically no more than about 3MHz, which corresponds to a horizontal resolution of about 240 lines.

This is only about half the luminance bandwidth and resolution capability of DVD video discs. These can usually provide a luminance bandwidth of about 6.4MHz, or just on 500 lines of resolution.

As a result, when you're transferring video from a VCR onto DVD via your PC, you may get better results by applying some judicious video enhancement or "sharpening". It's true that this also tends to degrade the video signal-to-noise ratio but most people feel that the overall picture quality is improved – provided that the sharpening isn't overdone.

In practice, your eyes can best judge how much enhancement is worthwhile and how much is "too much".

Sharpening techniques

There are two broad ways of providing this type of video enhancement. The most commonly used method is to apply "high peaking" to the video, so that the higher video frequencies are boosted and the effective horizontal resolution improved. This method certainly works but it also tends to produce visible "ringing", or multiple trailing edges after vertical transitions.

The other way of providing enhancement is to detect the vertical transitions in the video signal, then differentiate and amplify just these transitions to provide what is effectively an edge enhancement or "sharpening" signal. A selected amount of this sharpening signal is then added back into the video signal, to "steepen" the original transitions (ie, decrease the risetimes).

This method is a little harder to do but it does give better results. That's why we're using it in this new Video Enhancer project.

Note that regardless of which technique is used, the enhancement processing should only be done on the luminance (Y) component of the video signal. That's because this is the video component that conveys the picture contrast and detail information. There isn't much point in trying to sharpen the chrominance (C)

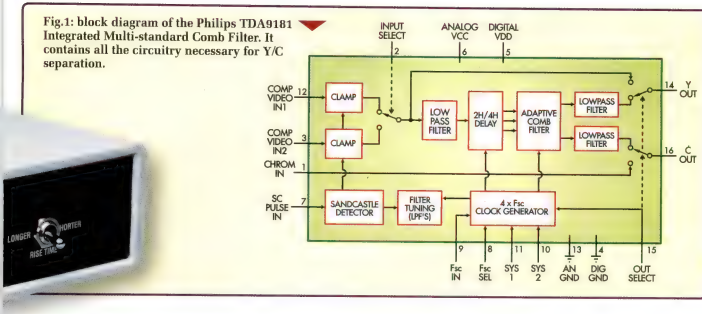


Fig.1: block diagram of the Philips TDA9181 Integrated Multi-standard Comb Filter. It contains all the circuitry necessary for Y/C separation.

components and in any case, this tends to produce various kinds of annoying colour distortion.

In short, the chrominance components are best left alone.

Y/C separation

Most traditional video enhancers use fairly simple analog filtering to separate the Y and C components before they enhance the luminance. However, this type of filtering is very much a compromise, as it results in some distortion of the chrominance. It also actually reduces the effective luminance bandwidth, which cancels out much of the potential benefit of any enhancement.

Because of this problem, we decided to use a better method of Y/C separation in this design: adaptive digital comb filtering. This provides greatly improved separation of the luminance and chrominance information, without distorting the chrominance or artificially reducing the luminance bandwidth. In short, it provides better results all round!

But that's not all. Comb filter Y/C separation has another important benefit: it allows the Enhancer to act as a composite video to S-video converter. By feeding the Enhancer's output signals to your PC's MPEG encoder in S-video form, you get a better quality signal transfer than takes place with composite video.

So that's the rationale behind our new Video Enhancer & Y/C Separator. It uses edge enhancement rather than simple high peaking, it has improved Y/C separation using digital comb filtering, and it also functions as a composite video to S-video converter for better transfer quality into an MPEG encoder. It also features a composite video output, for use with an encoder which doesn't have an S-video input.

The comb filter IC

Perhaps the most interesting part of our new Video Enhancer is the adaptive digital comb filtering, used to separate the Y and C components of the incoming video. This processing is all performed inside a single high-performance IC – the Philips TDA9181. This device is described by Philips as an "Integrated Multi-standard Comb Filter". As well as operating on PAL signals, it can alternatively be configured to separate NTSC signals.

Fig.1 shows what's inside this rather impressive IC. At first glance, it looks a bit complicated because, as well as the comb filtering circuitry, the TDA9181 also contains input and output signal selection switching. It's shown here with the internal switches in their correct positions for Y/C separation.

The incoming composite video enters the TDA9181 at pin 12 via a capacitor. It's then passed through a clamp circuit, to set the DC level of its sync pulse tips, and then fed to a low-pass filter. This filter removes any frequencies which are high enough to cause aliasing when the video is sampled for the comb filtering.

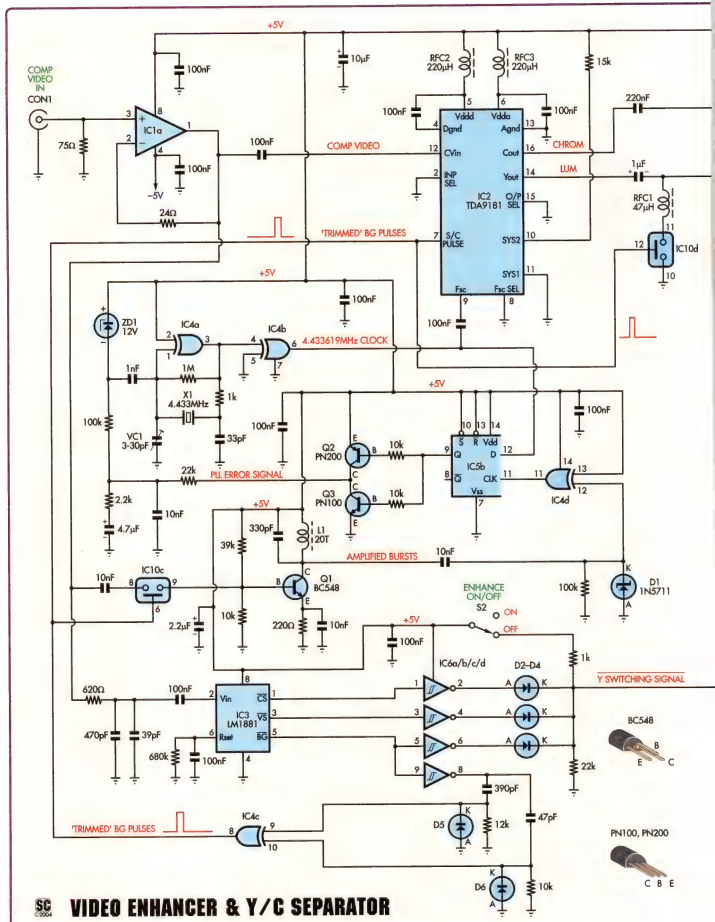
This sampling is performed at four times the colour subcarrier frequency (Fsc) – ie, 4 x 4.433MHz or 17.732MHz. As a result, the low-pass filter's cutoff frequency is still quite high at about 7MHz, which is well above any likely luminance components (especially in VCR video signals).

After low-pass filtering and 4Fsc sampling, the video signals pass through two delay lines connected in series. These each provide a time delay of two line periods (2H or 128µs), so there are three video output streams from the delay line section: (1) the original undelayed video signal; (2) a 128µs (2H) delayed version; and (3) a 256µs (4H) delayed version. All three video streams are then fed into the adaptive comb filter, which analyses them and adds/subtracts them in a dynamic "adaptive" way to "comb apart" (or separate) the Y and C information.

The fine details of comb filtering are a bit too complex to explain here but you'll find more information in the TDA9181 data sheet (just Google in your browser) if you want it.

After separation, the Y and C signals are each passed through low-pass "reconstruction" filters, to remove any sampling artefacts. They then emerge from pins 14 and 16 respectively, when the internal switching is set as shown.

In order to perform this impressive job of Y/C separation, the TDA9181 needs to be fed with two reference signals. The first is a "sandcastle" (SC) pulse signal, which is fed in via pin 7 and used mainly to gate the video input clamp circuits. If fully stepped


COMP VIDEO IN
CON1
75Ω
IC1a
100nF
-5V
24Ω
+5V
10µF
RFC2 220µH
RFC3 220µH
15k
100nF
Vddd
Vdda
Dgnd
Agnd
CVin
Cout
INP SEL
Yout
IC2 TDA9181
O/P SEL
S/C PULSE
SYS2
SYS1
Fsc
Fsc SEL
COMP VIDEO
CHROM
LUM
220nF
1µF
RFC1 47µH
IC10d
'TRIMMED' BG PULSES
ZD1 12V
IC4a
IC4b
4.433619MHz CLOCK
1nF
1M
X1 4.433MHz
1k
100k
VC1 3-30pF
33pF
22k
PLL ERROR SIGNAL
2.2k
4.7µF
10nF
Q2 PN200
Q3 PN100
10k
IC5b
Vdd
CLK
Vss
IC4d
330pF
L1 20T
39k
AMPLIFIED BURSTS
IC10c
Q1 BC548
2.2µF
220Ω
ENHANCE ON/OFF
S2
ON
OFF
D1 1N5711
IC6a/b/c/d
D2–D4
Y SWITCHING SIGNAL
620Ω
470pF
39pF
680k
IC3 LM1881
Vin
Rset
BC548
390pF
47pF
D5
12k
D6
IC4c
PN100, PN200
SC ©2004
VIDEO ENHANCER & Y/C SEPARATOR

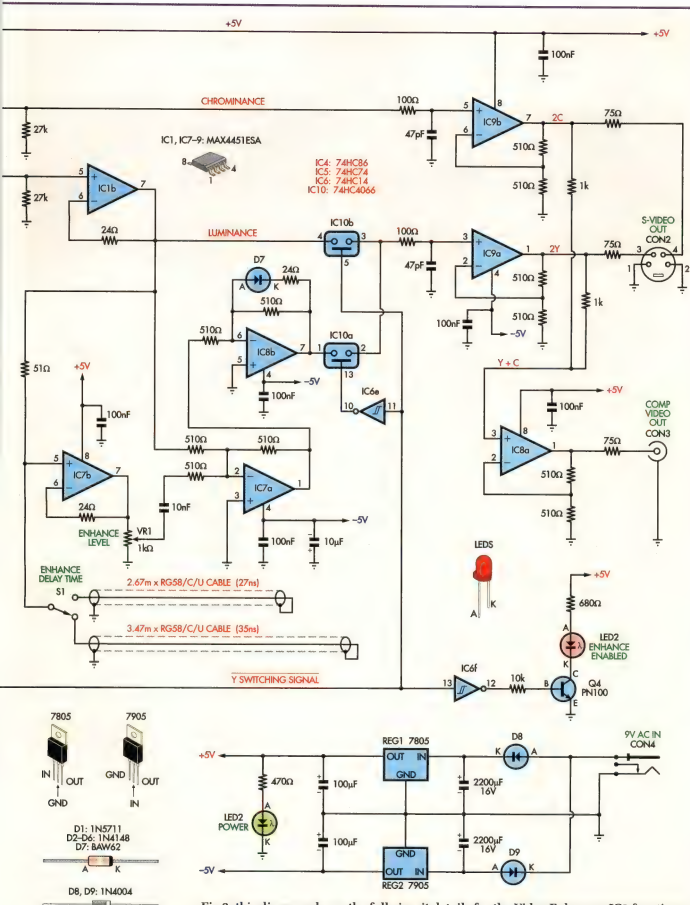


Fig.2: this diagram shows the full circuit details for the Video Enhancer. IC2 functions as the Y/C separator.

The rear panel of the unit carries four sockets: (1) composite video input; (2) composite video output; (3) S-video output; and (4) power.

sandcastle pulses are not available, colour burst gating pulses can be used instead (and that's what we do in this design).

The second reference needed is a colour subcarrier signal, which is used to lock the TDA9181's internal sampling clock to four times the colour subcarrier frequency (ie, 4Fsc or 17.73MHz). This reference signal is fed in via pin 9 and can have a frequency of either Fsc or 2Fsc, provided the chip is informed which is being used by taking control pin 8 either low or high. In this design, we feed in a reference signal at Fsc and tie pin 8 low.

Circuit details

Fig.2 shows the full circuit of the Video Enhancer. As shown, the incoming composite video from the VCR or some other source is fed in at CON1. It is then fed to IC1a which is half of a MAX4451 dual op amp, used here as a video input buffer. The output of this buffer stage is then fed to the input of IC2 (TDA9181) via a 100nF coupling capacitor. It is also fed to one side of analog switch IC10c and to the input (pin 2) of IC3, an LM1881 sync separator chip.

IC3 is used to derive the various sync and timing signals from the video: ie, composite sync (CS-bar), vertical sync (VS-bar) and a basic colour burst gating signal (BG-bar). These signals are then passed through Schmitt inverters IC6a-IC6d, to both invert them logically and "sharpen" them up.

We'll look more at the outputs of IC6a-IC6c later but for the present, note that the BG pulses from IC6d are "trimmed" in length to correspond more closely to the actual PAL colour burst length of 2.5µs. This trimming is done using a pair of RC differentiator circuits (390pF & 12kΩ and 47pF and 10kΩ), each feeding one input of XOR gate IC4c.

The trimmed BG pulses are then fed to pin 7 of IC2, to provide the "sandcastle" reference signal. They're also used to gate analog switch IC10c, which allows the buffered video input signal from IC1a to pass through to transistor Q1 only during the colour bursts.

Q1 is used to amplify the gated colour bursts, which appear across its load circuit, as formed by L1 and the parallel 330pF capacitor. These amplified bursts are then fed via a 10nF capacitor to diode D1 and a 100kΩ resistor, which clamp the negative burst tips to ground potential. They then go to pin 12 of XOR gate IC4d, which is used here as an inverter.

IC4a, IC4b, IC5b and transistors Q2 & Q3 are used to generate a 4.433619MHz clock signal for IC2, locked to the colour subcarrier bursts of the incoming video. IC4a is the oscillator and uses crystal X1 as its main frequency reference. Its output is then buffered by IC4b and fed to the D (data) input (pin 12) of flipflop IC5b.

As shown, the amplified and squared-up colour bursts are fed to IC5b's clock (CLK) input and this allows IC5b and transistors Q2 & Q3 to act as a gated phase detector. It compares the phase of IC4b's output with that of the gated colour bursts. The resulting DC error signal from Q2 & Q3 is then fed through a loop filter and a 100kΩ decoupling resistor to ZD1, a 12V zener diode used here as a varicap.

As a result, ZD1's capacitance is automatically varied to keep IC4b's output in lock with the colour bursts.

As well as gating IC10c, the trimmed BG pulses from IC4c are also used to gate analog switch IC10d. This switch is used as a DC level clamp on the separated Y signals which emerge from pin 14 of IC2, via a 1µF coupling capacitor. As a result, the separated Y signal fed to buffer stage IC1b has its sync tip level clamped firmly to ground potential.

Video enhancement

All of the circuitry we've looked at so far has essentially been used to convert the incoming composite video signals into S-video – ie, into separated Y and C (luminance and chrominance) signals. And that's about it as far as the C signals on pin 16 of IC2 are concerned.

As shown, they are now simply passed through a low-pass RC filter and then fed through wideband output buffer and cable driver stage IC9b. This stage operates with a gain of two, to compensate for losses in the 75Ω output terminating resistor.

The Y (luminance) signals don't have it quite so easy, because it's these that we operate on for video enhancement. In this case, the Y signals appear on pin 7 of IC1b and are then fed in three different directions: to analog switch IC10b; to pin 5 of IC7b (via a 51Ω resistor); and to pin 2 of IC7a via a 510Ω resistor.

Delay lines

Pin 5 of IC7b is also connected to earth via one of two delay lines, as selected by switch S1. Both delay lines are made from 50Ω RG58/C/U coaxial

cable, with their "far" ends shorted so that any signals which propagate along them are reflected straight back again. The cable lengths are carefully chosen to give a down-and-back "round trip" delay time of 27ns when the 2.67m length is selected or 35ns when the 3.47m length is selected.

What's the idea of this? Well, the action of the delay line is to generate an opposite polarity version of the Y signal from IC1b but delayed by the selected short period of time (ie, 27ns or 35ns). This delayed opposite-polarity version is added to the original Y signal at pin 5 of IC7b, so all signal changes which last longer than the selected delay time will be cancelled out.

As a result, only relatively rapid transitions will escape this cancellation and so IC7b's output consists of a series of short positive and negative-going spikes, representing only these faster transitions. These spikes can be considered as a kind of "differentiated" version of the Y signal and they become our enhancement signal.

Following IC7b, the enhancement signal is fed to IC7a where it is mixed with the original Y signal from IC1b. Potentiometer VR1 acts as the enhancement level control.

The enhanced Y signals from the mixer (IC7a) are then fed to IC8b, which re-inverts them to compensate for the inversion in IC7a. At the same time, diode D7 clips any negative-going enhancement spikes, to make sure they don't act as fake extra sync pulses.

Fast electronic switching

Now we come to analog switches IC10b and IC10a, which are used to select either the original Y signal direct from IC1b or the enhanced signal from IC8b. These switches are controlled in complementary fashion, because inverter IC6e feeds the gate of IC10a with an inverted version of the control signal fed to the gate of IC10b. So IC10a is "off" when IC10b is "on" and vice-versa.

Basically, IC10a and IC10b form an electronic SPDT switch, which allows us to select either the original Y signal or the enhanced version. The selected signal is then fed to the Y signal output buffer (IC9a).

The reason for this switching is that we don't want to disturb the critical sync pulses or colour bursts on the Y signals as part of the enhancement processing. As a result, we use fast electronic switching to feed "undoctored" Y information through to the output when any of this critical information is present and only make the enhanced Y information available during the active parts of the video lines.

The signal that's used to perform this switching is generated from those sync and burst gating outputs from IC6a-IC6c which we looked at earlier. As shown, these outputs are combined in a simple 3-input OR gate using diodes D2-D4 and a 22kΩ resistor to ground. This produces a switching signal which is high during any

Parts List

1 PC board, code 02108041, 198 x 157mm (double sided – see text)
1 ABS plastic instrument box, 225 x 165 x 40mm
1 47µH RF choke (RFC1)
2 220µH RF chokes (RFC2,RFC3)
1 miniature 4.8mm coil former, base & shield can
1 F16 ferrite slug to suit coil former above
1 short length of 0.25mm enamelled copper wire
2 SPDT miniature toggle switches (S1,S2)
1 4.433MHz crystal, HC/49U or HC/49US (X1)
1 U-shaped TO-220 heatsink, 19mm x 19mm x 9.5mm
2 PC-mount RCA sockets, yellow (CON1,CON3)
1 4-pin mini DIN socket, PC-mount (CON2)
1 2.5mm concentric power socket, PC-mount (CON4)
1 6.2m length of RG58/C/U 50Ω coaxial cable
6 100mm-long nylon cable ties
1 1kΩ 16mm-diameter linear pot (VR1)
1 small skirted instrument knob to suit VR1
4 PC terminal pins, 1mm diameter
6 6mm-long self-tapping screws (for board mounting)

Semiconductors

4 MAX4451ESA dual wideband op amps (IC1,IC7,IC8,IC9)
1 TDA9181 multi-standard Y/C comb filter (IC2)
1 LM1881 sync separator (IC3)
1 74HC86 quad XOR gate (IC4)
1 74HC74 dual flipflop (IC5)
1 74HC14 hex Schmitt trigger (IC6)
1 74HC4066 quad analog switch (IC10)
1 LM7805 +5V regulator (REG1)
1 LM7905 -5V regulator (REG2)
1 BC548 NPN transistor (Q1)
1 PN200 PNP transistor (Q2)
2 PN100 NPN transistors (Q3,Q4)
1 12V zener diode (ZD1)
1 3mm green LED (LED1)
1 3mm red LED (LED2)
1 1N5711 Schottky diode (D1)
5 1N4148 or 1N914 diodes (D2-D6)
1 BAW62 high speed diode (D7)
2 1N4004 1A diodes (D8,D9)

Capacitors

2 2200µF 16V RB electrolytic
2 100µF 16V RB electrolytic
2 10µF 16V tantalum
1 4.7µF 16V tantalum
1 2.2µF 16V tantalum
1 1µF 16V tantalum
1 220nF MKT polyester
4 100nF MKT polyester
15 100nF monolithic ceramic
1 10nF MKT polyester
4 10nF monolithic ceramic
1 1nF disc ceramic
1 470pF disc ceramic
1 390pF disc ceramic
1 330pF disc ceramic
3 47pF NPO disc ceramic
1 39pF NPO disc ceramic
1 33pF NPO disc ceramic
1 3-30pF trimmer (VC1)

Resistors (0.25W, 1%)

1 1MΩ	4 1kΩ
1 680kΩ	1 680Ω
2 100kΩ	1 620Ω
1 39kΩ	11 510Ω
2 27kΩ	1 470Ω
2 22kΩ	1 220Ω
1 15kΩ	2 100Ω
1 12kΩ	4 75Ω
5 10kΩ	1 51Ω
1 2.2kΩ	4 24Ω

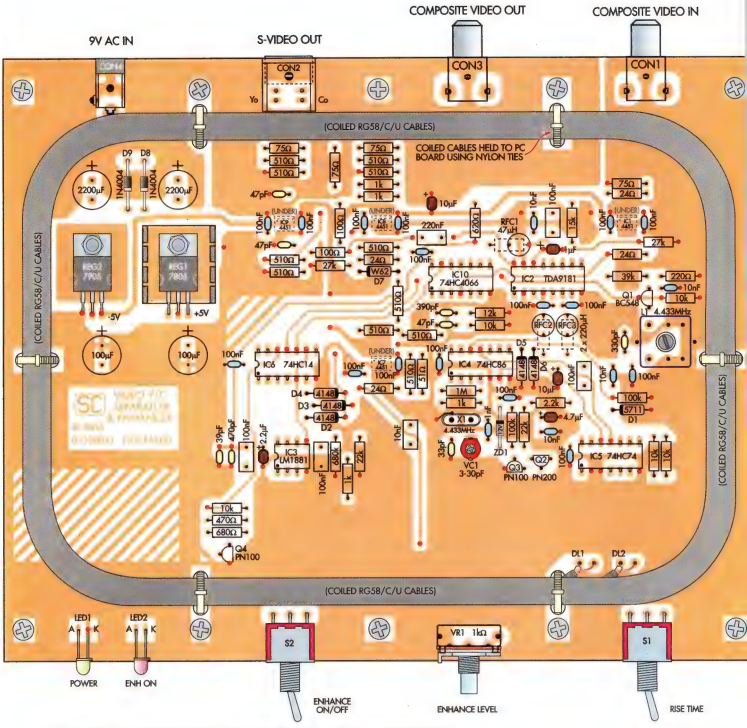


Fig.3: install the parts on the PC board as shown here (top copper shown). The red dots indicate where component leads and "feed-throughs" have to be soldered on both sides, if you don't have a board with plated-through holes.

of the critical sync and burst gating periods and low at all other times.

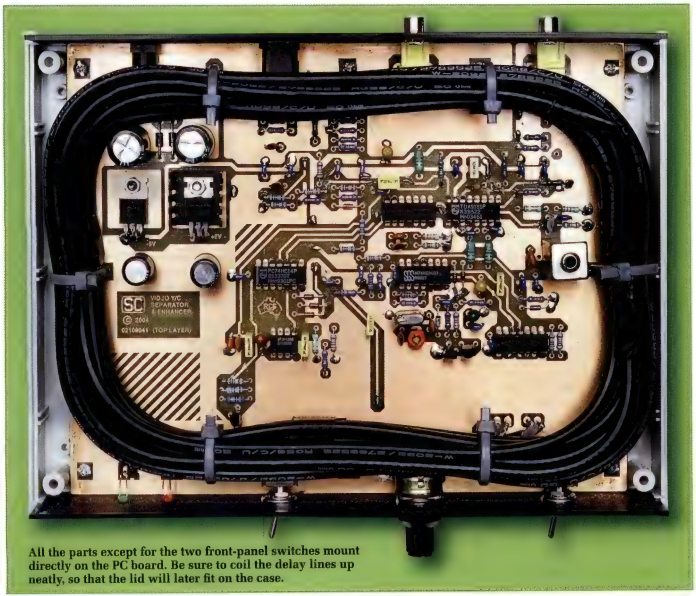
As a result, IC10b is turned on during the critical periods, while IC10a is on at all other times.

At least that's what happens when switch S2 is in the "On" position. However, if S2 is set to "Off" instead, the Y switching signal line is pulled to +5V (via a 1kΩ resistor), preventing it from going low during the active video line periods. In this case, IC10b remains on continuously, while IC10a remains off and so only "undoctored" Y information is fed to output buffer IC9a – ie, the enhancement is disabled.

Inverter IC6f and transistor Q4 are used to drive LED2 from the Y switching signal line. This means that LED2 is only turned on when the switching line is at low logic level, corresponding to those times when IC10a is turned on to pass the enhanced Y signal. As a result, LED2 functions as an "Enhancement Enabled" indicator.

Output buffer stages

The Y and C signal output buffer stages based on IC9a and IC9b are virtually identical. Both stages have a simple RC low-pass input filter. IC9a's filter is there to remove switching transients, while IC9b's filter is included simply to match the delay and phase shifts in IC9a's filter. The outputs of both stages are fed to the S-video



All the parts except for the two front-panel switches mount directly on the PC board. Be sure to coil the delay lines up neatly, so that the lid will later fit on the case.

output socket (CON2) via 75Ω back terminating resistors.

The alternative recomposited video output signal for CON3 is generated by feeding the separated Y and C output signals to the non-inverting input of buffer stage IC8a via 1kΩ mixing resistors. As with the other two output buffers, IC8a operates with a gain of two, to compensate for the loss in its 75Ω back terminating resistor.

Power supply

All of the circuitry in the Video Enhancer operates from either +5V or ±5V rails.

The power supply is really quite simple. As shown, power is derived from a 9V AC plugpack supply and this feeds half-wave rectifier diodes D8 & D9. The resulting DC rails are then fed to 3-terminal regulators REG1 & REG2, which produce the regulated +5V and -5V rails.

The 2200µF and 100µF capacitors provide supply line filtering and decoupling, while LED2 provides power indication.

Construction

Despite the circuit complexity, the construction is straightforward, with all parts mounted on a single PC board. This board is coded 02108041, measures 198 x 157mm and fits snugly in a standard low profile ABS instrument box measuring 225 x 165 x 40mm.

Note that the board is double-sided, with the top copper used partly as a groundplane. However, unless this board is supplied with plated-through holes, you will have to fit short wire "feed-throughs" (or links) at various locations on the board, to connect the copper pads on each side. You'll also have to solder some of the component and IC leads to both sides of the PC board or in some cases, to the top copper only.

That's not as daunting as it sounds. To make it easy, all the wire feed-throughs and "top solder" points are marked with a red dot on the parts layout diagrams – see Figs.3 & 4.

As shown in the photo, the two lengths of RG58/C/U coaxial cable used for the enhancement delay lines are coiled up together and secured to the top of the PC board using nylon cable ties. It's a bit of a squeeze but they do fit in.

Before fitting any parts to the board, inspect it carefully with a magnifying glass to make sure there are no etching defects or solder plating problems. It's much easier to find and remedy these

Table 1: Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	1MΩ	brown black green brown	brown black black yellow brown
1	680kΩ	blue grey yellow brown	blue grey black orange brown
2	100kΩ	brown black yellow brown	brown black black orange brown
1	39kΩ	orange white orange brown	orange white black red brown
2	27kΩ	red violet orange brown	red violet black red brown
2	22kΩ	red red orange brown	red red black red brown
1	15kΩ	brown green orange brown	brown green black red brown
1	12kΩ	brown red orange brown	brown red black red brown
5	10kΩ	brown black orange brown	brown black black red brown
1	2.2kΩ	red red red brown	red red black brown brown
4	1kΩ	brown black red brown	brown black black brown brown
1	680Ω	blue grey brown brown	blue grey black black brown
1	620Ω	blue red brown brown	blue red black black brown
11	510Ω	green brown brown brown	green brown black black brown
1	470Ω	yellow violet brown brown	yellow violet black black brown
1	220Ω	red red brown brown	red red black black brown
2	100Ω	brown black brown brown	brown black black black brown
4	75Ω	violet green black brown	violet green black gold brown
1	51Ω	green brown black brown	green brown black gold brown
4	24Ω	red yellow black brown	red yellow black gold brown

at this stage than later on.

Begin the assembly by fitting the four input and output connectors along the rear edge of the board. That done, if your board doesn't have plated-through holes, fit the small number of short wire "feed-throughs" at the positions indicated. There aren't many of these but they are best done now to make sure you don't forget them.

Next, fit the four PC board terminal pins that are used to terminate the connections to the coaxial delay lines. These fit in the front right of the board.

The resistors, diodes and capacitors can all now be installed. Table 1 shows the resistor colour codes but it's also a good idea to check each value using a digital multimeter before installing it on the PC board.

Take care to ensure that the diodes and electrolytics go in with the correct polarity. Take care also to ensure that the correct diode is installed at each location. In particular, note that D1 is a 1N5711, D7 is a BAW62 and D8 & D9 are 1N4004s. The remaining diodes (D2-D6) are all 1N4148s.

Don't forget to solder any leads marked with a red dot on the wiring diagrams to the top copper as well as underneath.

Once these parts are all in, install trimmer capacitor VC1. This should be installed with its flat side towards crystal X1 as shown. That done, you can wind the 4.433MHz peaking coil (L1) – see Fig.5. This consists of just 20 turns of 0.25mm enamelled copper wire, wound close together at the bottom of a miniature 4.8mm OD former.

Note that the former is fitted with an F16 ferrite slug for tuning. It is then fitted to the board with the coil connections adjacent to the 330pF capacitor. A matching shield can fits over the coil assembly and is secured by soldering its tags to the bottom copper.

The three RF chokes (RFC1-3) and quartz crystal X1 can go in next. Note that the 47μH RF choke is used as RFC1 and that a short length of tinned copper wire is used to earth the shield can of X1 and to make sure the crystal is held firmly in place. The two crystal leads are soldered to the underside copper only.

The four transistors (Q1-Q4) can now be installed, followed by 3-terminal regulators REG1 & REG2. Again, take care to ensure that the correct device is used at each location and that it is oriented correctly. Push each transistor as far down onto the board as it will comfortably go before soldering its leads.

Table 2: Capacitor Codes

Value	μF Code	EIA Code	IEC Code
220nF	0.22μF	224	220n
100nF	0.1μF	104	100n
10nF	.010μF	103	10n
1nF	.001μF	102	1n
470pF	–	471	470p
390pF	–	391	390p
330pF	–	331	330p
47pF	–	47	47p
39pF	–	39	39p
33pF	–	33	33p

The two regulators lie flat against the PC board. Before mounting them, you will need to bend their leads down through 90°, so that they will go through their respective solder holes (and so that the metal tab on each device lines up correctly with its mounting hole).

That done, REG2 (7905) can be installed and bolted down directly against the board copper using a 10mm x 3mm machine screw and nut. REG1 (7805) is mounted in similar fashion but must also have a 19mm x 19mm U-shaped heatsink sandwiched between it and the PC board.

The device leads should be soldered

only after REG1 and REG2 have been bolted in position. Note that all three pins of REG2 must be soldered to the top copper, while only the centre pin of REG1 needs this.

Installing the ICs

The leaded DIP ICs should now be fitted to the top of the board, taking the usual care to prevent them being damaged by overheating or electrostatic charge. Be sure to earth yourself while you're handling these ICs and use an earthed soldering iron when you're soldering their leads.

Note again that some of the IC leads need to be soldered to the top copper as well as underneath, as shown by the red dots.

The final ICs to fit are the four MAX4451ESA chips (IC1, IC7, IC8 & IC9). These are in SOIC-8 SMD packages and mount on the underside of the board – see Fig.4. As shown, all four mount with their chamfered side towards the rear of the board.

Take care when soldering them in place, so that you don't overheat them or leave solder bridges their between pins. The best way to approach the job is to first lightly tin the IC pads using a soldering iron with a fine-pointed tip. You can then "cement" each device in position using a tiny spot of epoxy glue before soldering their leads.

Hardware & delay lines

The next step in the assembly is to install the Enhance Level potentiometer (VR1). To do this, first cut its shaft to about 9mm long, then push the pot all the way down onto the board and solder its terminals.

By contrast, the two switches aren't directly mounted on the board. Instead, you should install five 30mm lengths of insulated hookup wire at the switch positions – three for S1 and two for S2 (left and centre). The free ends of these wires are then later soldered to the switches, which mount directly on the front panel.

Delay lines

You are now ready to prepare and fit the two coaxial cable delay lines. Begin by cutting off two lengths of RG58/C/U coaxial cable, one 3480mm long and the other 2680mm long.

Next, carefully remove a 5mm length of the outer sleeving from both ends of these cables and unplait the screening braids at these ends. That done, on one end of each cable, gently fan out the screening wires and carefully remove about 3mm of the inner dielectric to reveal the centre conductor.

Now bend the screening wires on each cable back down again, twist them around the bared inner conductor and solder the connections – ie, the shielding braid is soldered to the inner conductor at one end of each cable (see Fig.2). Once the solder joints have been completed (and have cooled), wind a short piece of insulating PVC tape over these ends to protect them from damage.

Moving now to the other end of each cable, again fan out the braid wires and remove about 3mm of the inner dielectric to reveal the centre conductor. At these ends though, the individual shield wires are simply twisted together on each cable, to form the earth leads.

The next step is to solder these inner and outer wires of each cable to the terminal pins on the PC board – see Figs.3. As shown, the connections for the shorter delay line (DL1) go to the pins on the left, while those for the longer line (DL2) go to those on the right. In both cases the centre conductor goes to the left.

After soldering the cables, fit 100mm-long nylon cable ties through the six pairs of 3mm holes around the edge the board. Each cable tie should be fed down through its inner hole and then back up through the outer hole, to give two ends of equal length. They will then all be in a "U" shape, ready for you to loop the two delay line cables around inside them.

Because the cables are fairly stiff and bulky, you might find it easier to

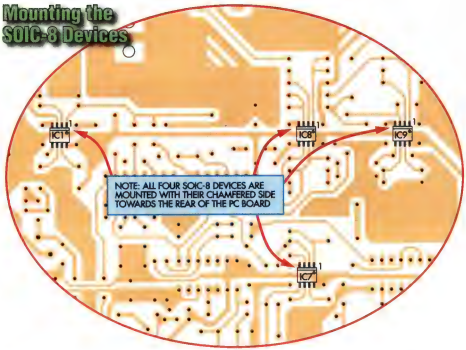


Fig.4: the four MAX4451ESA dual op amps are all mounted on the underside of the PC board, as shown here. Make sure you install them the right way around.

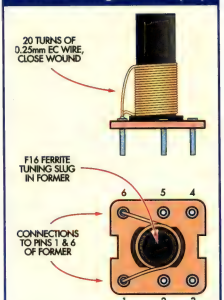


Fig.5: follow this diagram to wind the 4.433MHz peaking coil. It uses 20 turns of enamelled copper wire and is fitted with a tuning slug.

There are just three front panel controls: an enhancement on or off switch, an enhancement level pot, and an enhancement rise time switch.

use narrow strips of gaffer tape to hold each loop in position, before winding on the next loop above it. At the very least, it will reduce the frustration level to a dull roar.

When the end of the shorter cable is reached, you can form each cable tie into a loosely closed loop. This helps hold all the twin cable loops in place while you thread through the last part of the longer cable. Finally, when this is in place too, you can tighten up the cable ties in stages as you tidy up the cable loop layers.

Make sure that the delay line loops pack down into a compact shape that will fit inside the Video Enhancer's case. This is a rather fiddly operation, but take it steady and keep your cool because it can be done – as you can see from the photos.

After the cables are in place and tied down securely to the board, you can fit the last components to the board itself. These are the two LEDs, which mount in the front lefthand corner. Both LEDs are fitted with their longer anode lead towards the left, with the green Power LED on the left and the red Enhance LED on the right.

Initially, the LEDs should be mounted vertically, with their bodies about 16mm above the board. Once they're in position, bend their leads forward by 90° about 9mm up from the board, so that they will later mate with their matching holes in the front panel.

Final assembly

Now for the final stage of assembly. If you purchase a complete kit, the case will be supplied pre-drilled and with screen-printed lettering. If not, then you'll have to drill your own holes in the front and rear panels.

Use the panel artwork (it can be downloaded from the SILICON CHIP website) as a drilling guide if you do have to drill the holes yourself. You'll need 12mm holes for the RCA sockets and the 4-pin mini-DIN socket, a 9mm hole for the power input connector CON4, 7mm holes for the front panel switches and pot, and 3mm holes for the two LEDs.

By the way, for the larger holes, it's best to drill small pilot holes first and then carefully enlarge them to size using a tapered reamer.

Once the panels have been drilled, you can attach the artworks, then fit the two toggle switches to the front panel. That done, you can make the connections between these switches and the PC board, by soldering the ends of the five wires you fitted earlier to the appropriate switch lugs. Just be careful not to burn the delay line cables with the hot soldering iron barrel while you're doing this.

It's now just a matter of installing everything inside the case. First, slip the front panel over the LEDs and the pot shaft, and loosely fit the pot nut to hold the assembly together. That done, fit the rear panel over the RCA sockets and lower the complete assembly into the bottom half of the case. The board is then secured in place using six short self-tapping screws – three along the front of the board and three along the rear.

There's really no need to fit screws in the remaining four holes, although you can do so if you wish.

Once the board assembly is in place, you can tighten up the pot nut to hold it securely in position. Finally, push the knob over the pot shaft and you're ready for the smoke test!

Checkout time

Connect a 9V AC plugpack to CON4 and apply power. The green Power LED should immediately begin glowing; if it doesn't, switch off immediately and look for the cause. You may have wired in the LED with reversed polarity or fitted one of the power diodes or electrolytic capacitors the wrong way around.

You can check that the power supply is working correctly by measuring the DC voltage at the righthand output pins of both REG1 and REG2. You should get readings of +5V and -5V respectively (within a few tens of millivolts).

Now feed some composite video from a VCR (or camcorder) into CON1 and use an oscilloscope or a DMM with an RF detector probe to measure the AC voltage across diode D1 (between L1 and IC5). This will allow you to adjust the tuning slug in coil L1 – just tune the coil for a peak in the diode voltage, to obtain the maximum gain in burst amplifier Q1.

Once L1 has been peaked, the only remaining adjustment is to set trimmer VC1 so that the subcarrier oscillator is correctly locked to the video colour bursts. This isn't hard to do if you have a frequency counter and/or an oscilloscope. If you have a counter, connect its input to the output of IC4b and read the oscillator's frequency. If it isn't exactly 4.433619MHz, adjust VC1 until you get this reading consistently.

If you have an oscilloscope (but no counter), connect it to the junction of the 100kΩ, 22kΩ and 2.2kΩ resistors, just to the right of zener diode ZD1. If the oscillator is correctly locked, you should see a small sawtooth signal at a DC level of about +2.5V. If not, adjust VC1 until you do get this.

If you have neither a scope nor a counter, set VC1 to the centre of its range and try connecting the S-video output of the Video Enhancer (CON2) to the S-video input of your TV or projector. You should see nice, clear pictures, indicating that the unit's colour subcarrier oscillator is locked to 4.433619MHz and that everything else is working correctly.

If not and the pictures are distorted and flashing with various colours, try adjusting VC1 slowly until the pictures do stabilise and become clear.

That's it – fit the lid on the case and your new Video Enhancer and Y/C Separator is ready for action. **SC**

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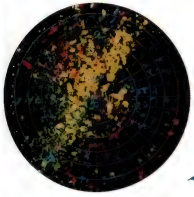

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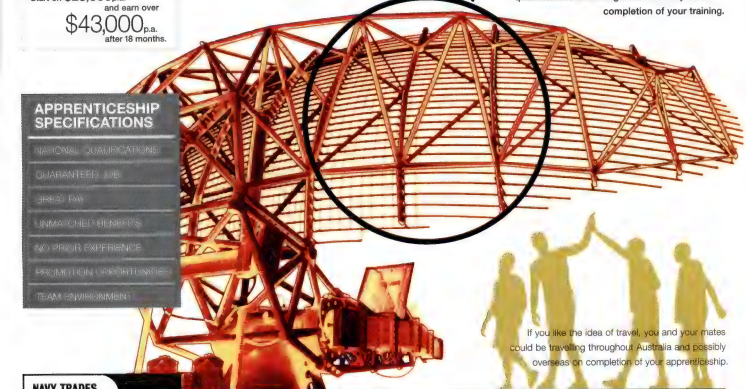

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Balanced Microphone Preamp

This Balanced Microphone Preamp comes with a 3-band equaliser and is suitable for Karaoke, public address or many other applications. It can run from a plugpack, its own internal 9V battery or phantom power.

by JOHN CLARKE

Main Features

- Balanced input for microphone
- Balanced and unbalanced output
- Level control
- 3-band equaliser
- Runs from battery, plugpack or phantom power
- Battery indicator
- Ground lift
- Rugged diecast housing

WHETHER IT IS FOR karaoke, public address or for a band, a microphone connection to an amplifier is a basic requirement. This Balanced Microphone Preamplifier includes a 3-band equaliser and can be used to drive a guitar amplifier, any stereo amplifier or provide an additional channel for a public address amplifier.

Balanced microphones are desirable since they prevent the injection of hum and noise into the sound system. A balanced microphone has a 3-wire cable usually connected via XLR plugs and sockets. XLR pin 1 is the return or ground and the other two terminals (pins 2 & 3) are for the signals. The signals are in anti-phase; in other words when one line goes positive, the other line swings negative by the same amount. Any hum that is picked up along the lead is effectively cancelled because the same level of hum will be present in both signal lines.

The 3-band equaliser (bass, mid and treble controls) is handy for enhancing a musical instrument so that it sounds natural when played through the microphone or to remove sibilance (the whistle sound from a voice particularly when pronouncing the letter "s") by reducing the treble level and boosting the mid range. Or the bass control can be reduced to suppress popping noises which occur when speakers hold the microphone too close.

A level control is included to prevent overload and a "ground lift"

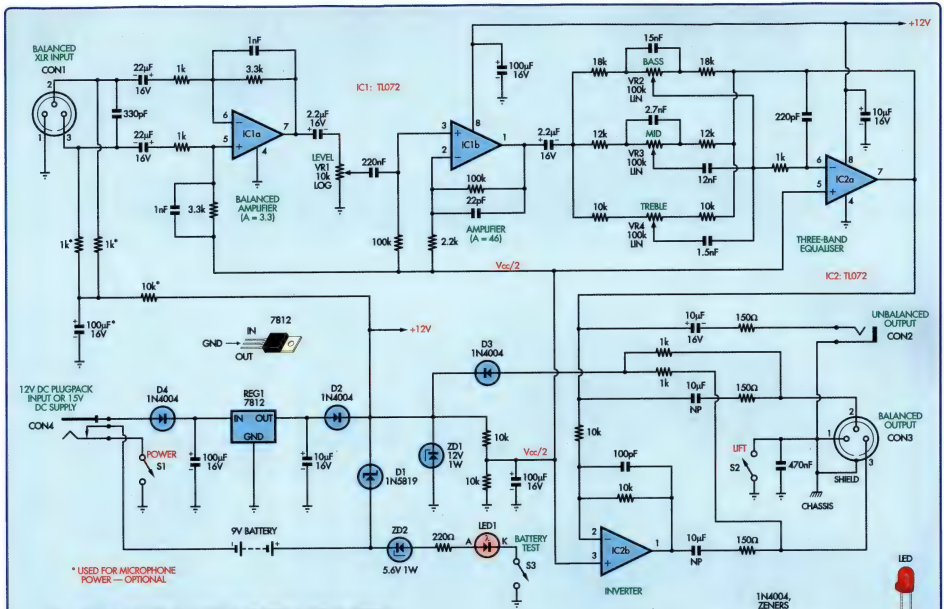


Fig.1: the circuit is based on two low-cost dual op amps: IC1a & IC2. IC1a functions as a balanced to unbalanced preamplifier, while IC1b functions as a non-inverting amplifier with a gain of 46. IC2a, VR2, VR3 & VR4 make up the equaliser stage, while IC2b provides an out-of-phase signal for pin 3 of CON3.

Parts List

1 PC board, code 01108041, 102 x 89mm.
1 metal diecast box, 119 x 94 x 57mm (Jaycar HB5064)
1 front panel label, 112 x 88mm
2 SPST ultra-mini rocker switches (S1-S2)
1 momentary-contact pushbutton switch (S3)
1 PC-mount 9V battery holder
1 mono 6.35mm panel-mount jack socket
1 3-pin male XLR panel-mount connector
1 3-pin female XLR panel-mount connector
1 2.5mm PC-mount DC socket
1 PC-mount 10kΩ 16mm log potentiometer (VR1)
3 PC-mount 100kΩ 16mm linear potentiometers (VR2-VR4)
4 knobs to suit potentiometers
4 stick-on rubber feet
4 M3 tapped x 6mm Nylon spacers
12 M3 x 6mm screws
1 M3 x 10mm screws
1 M3 nut
3 M2.5 x 6mm screws
1 3mm eyelet crimp connector
12 PC stakes
1 200mm length green hookup wire
1 200mm length pink hookup wire
1 200mm length orange hookup wire
1 200mm length blue hookup wire
1 200mm length red hookup wire
1 200mm length purple hookup wire

Semiconductors

2 TL072 dual op amps (IC1, IC2)
1 1N5819 Schottky diode (D1)
3 1N4004 diodes (D2-D4)
1 12V 1W zener diode (ZD1)
1 5.6V 1W zener diode (ZD2)
1 5mm red LED (LED1)

Capacitors

3 100µF 16V PC electrolytic
1 100µF 16V PC electrolytic (optional)
2 22µF 16V PC electrolytic
3 10µF 16V PC electrolytic
2 10µF 16V non-polarised (NP or BP) electrolytic
2 2.2µF 16V PC electrolytic
1 470nF MKT polyester
1 220nF MKT polyester
1 15nF MKT polyester
1 12nF MKT polyester
1 2.7nF MKT polyester
1 1.5nF MKT polyester
2 1nF MKT polyester
1 330pF ceramic
1 220pF ceramic
1 100pF ceramic
1 22pF ceramic

Resistors (0.25W 1%)

2 100kΩ	2 3.3kΩ
2 18kΩ	1 2.2kΩ
2 12kΩ	7 1kΩ
4 10kΩ	1 220Ω
3 10kΩ (optional)	3 150Ω

switch can reduce hum in some situations.

Circuit details

Let's now have a look the circuit in Fig.1. It uses two low-cost op amp ICs, four potentiometers, an XLR socket and plug, a 6.35mm jack socket, several switches and a few other low-cost parts.

Op amp IC1a functions as a balanced to unbalanced preamplifier with a modest gain. The balanced microphone signal is fed to pins 5 & 6 of IC1a via 22µF capacitors and 1kΩ resistors. Gain for the inverting input is set at -3.3 by the 3.3kΩ feedback resistor from pin 7 to pin 6. Frequencies above 48kHz are rolled off by the 1nF capacitor across the 3.3kΩ feedback resistor.

For the non-inverting input (pin 5), the input signal is attenuated by a factor of 0.77 due to the 3.3kΩ resistor connecting to Vcc/2. Overall gain for this signal path is therefore 0.77 x 4.3 or +3.3. Thus, the signal gain for both signal paths is the same.

The 330pF capacitor between pin 2 and pin 3 of the XLR socket shunts high frequencies so that the Preamplifier does not detect radio frequencies. The output of IC1a is fed to the level potentiometer, VR1, via a 2.2µF capacitor and then to pin 3 of op amp IC1b. This provides a gain of 46 by virtue of the 100kΩ feedback resistor between pins 1 & 2 and the 2.2kΩ resistor to the half supply rail (Vcc/2). IC1b drives the following 3-band equaliser stage via a 2.2µF capacitor.

EQ controls

The equaliser stage is based on op amp IC2a and potentiometers VR2, VR3 and VR4. These potentiometers and their associated resistors and capacitors are in the feedback path between pins 6 & 7. This circuit is identical to the 3-band equaliser used in the DI Box for Musicians described in August 2001.

Each of the Bass (VR2), Midrange (VR3) and Treble (VR4) feedback networks are effectively in parallel and act more or less independently (ie, with modest interaction). When the tone pots are all centred, the gain over their respective frequency ranges is unity (-1) and therefore the overall frequency response is flat.

Let's now look at the Bass control in more detail. When we wind the wiper of VR2 fully clockwise toward the output of IC1b, the input resistance for IC2a now decreases to 18kΩ while the feedback resistance increases to 118kΩ. At the same time, the 15nF capacitor is completely in the feedback circuit across the 118kΩ resistance. Without this capacitance the gain would be -118kΩ/18kΩ or -6.5 (ie, +16dB boost). The addition of the capacitor forces the circuit to give this gain below 100Hz and this reduces towards -1 as the frequency increases.

Conversely, when the pot's wiper is wound towards IC2a (anti-clockwise), the gain without the capacitor is 18kΩ/118kΩ or -0.15 (ie, -16dB cut). The 15nF capacitor is now on the input side so the gain rapidly increases to -1 at frequencies above 100Hz. Maximum bass cut is below 100Hz.

The midrange section with VR3 works in a similar manner except that there is now a 12nF capacitor in series with the input. This combines with the 2.7nF capacitor across VR3 to give a bandpass filter.

Finally, the treble control (VR4) operates with only a 1.5nF capacitor in series with the wiper. As a result, this control produces a high frequency boost or cut at 10kHz. Response curves for the tone controls are shown in Fig.2.

The 220pF capacitor across IC2a's

feedback path provides high frequency rolloff to prevent instability. Similarly, the 1kΩ resistor at the inverting input acts as a stopper for RF signals to prevent radio pickup.

IC2a's output at pin 7 drives the unbalanced output at CON2 via a 10µF capacitor and 150Ω resistor. IC2a's output also drives pin 2 of the XLR output socket CON3, again via a 10µF capacitor and 150Ω resistor. As well, IC2a's output drives inverting amplifier IC2b. This has a gain of –1 to derive the out-of-phase signal for pin 3 of CON3.

The remaining pin on the XLR plug is the ground pin (pin 1). This is either directly connected to ground via switch S2 or AC-coupled to ground via a 470nF capacitor. Opening the ground lift switch (S2) prevents a hum loop if the input is separately earthed. This is not likely to occur with a microphone but there may be separate grounds connected when the unit is used to convert a balanced line to an unbalanced output.

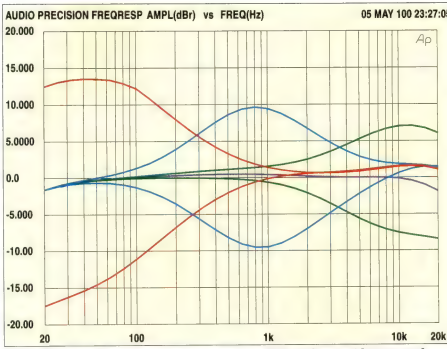


Fig.2: this graph shows the responses generated by the bass, mid-range and treble controls. The maximum bass boost is 12dB at 100Hz, while maximum mid-range boost is about 9dB at 850Hz. The treble boost is limited to about 7dB at 11kHz.

Power supply

Power for the circuit can come from a DC plugpack, internal 9V battery or via phantom power. Diode D4 provides reverse polarity protection for external DC power sources such as a plugpack. The DC supply rail is then filtered and applied to 3-terminal regulator REG1 to provide the +12V rail which is then fed to IC1 and IC2 via diode D2.

The internal battery supply is fed to the op amps via Schottky diode D1. A Schottky diode has a lower voltage drop than a standard diode and this extends the battery life.

Note that the negative return of the battery goes via the DC power socket. Hence, the battery is disconnected whenever a plug is inserted into the DC power socket.

Phantom power is delivered via pins 2 & 3 of the XLR plug and applied via two 1kΩ resistors to diode D3. Zener diode ZD1 regulates the voltage to 12V before it is applied to the rest of the circuit. This phantom power is usually produced from a source of either 48V with a 3.4kΩ impedance or from 24V with a 600Ω impedance. We can draw up to 7.5mA from each supply or 15mA in total at 12V.

Diodes D1, D2 & D3 isolate each supply so that only one source can deliver power to the circuit. Essentially, where more than one supply is connected, it is the highest voltage source that powers the unit.

The half-supply rail (Vcc/2) is obtained using two 10kΩ resistors connected in series across the power supply. The half supply point is decoupled using a 100µF capacitor to filter out any supply ripple.

Switch S3, LED1, ZD2 and the series 220Ω resistor form a simple battery indicator. If the voltage is 9V, the voltage across the 220Ω resistor will be 9V - 5.1V - 1.8V (the LED voltage drop) or 2.1V. As a result, a current of 9.5mA will flow through LED1 when S3 is closed. This will cause the LED to glow brightly.

As the battery voltage goes down, the current through the LED drops accordingly and so its brightness also decreases. For example, a battery voltage of 7.5V will only leave about 0.6V across the 220Ω resistor and so just 2.7mA will flow through the LED which will then be quite dim.

Building it

Most of the parts for the Balanced Microphone Preamplifier are mounted on a PC board coded 01108041 meas-

Specifications

Sensitivity	6.8mV input for 1V output
Signal Handling	2.3V RMS with equaliser set to flat response and 12V supply; 1.8V RMS at 9V supply
Input Impedance	1kΩ
Frequency Response	-3dB at 30Hz and 19kHz
Equaliser Response	+11db and –11db boost or cut at 100Hz; +9.6 and –10dB boost or cut at 1kHz; +7.4 and –8.4dB at 10kHz
Signal-To-Noise Ratio	-80dB with respect to 1V out and 20Hz to 20kHz bandwidth; -85dB A-weighted
Phase Difference at Balanced Outputs	180° at 1kHz; 160° at 20kHz
Battery Current	8.8mA at 9V

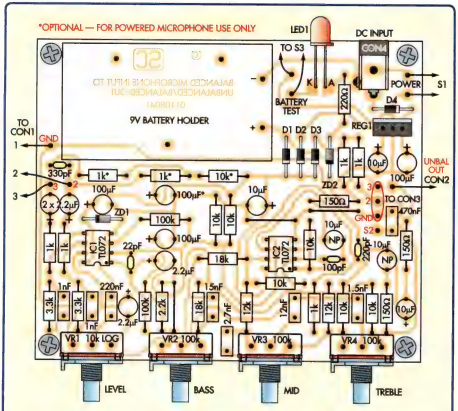


Fig.3: install the parts on the PC board as shown here. The components marked with an asterisk are optional and are installed only if you are using a phantom powered microphone or an externally powered microphone.

uring 102 x 89mm. This is housed in a metal diecast box measuring 119 x 94 x 57mm. The diecast case serves to provide shielding for the audio circuitry and makes the unit extremely rugged – a necessary requirement for stage work.

Fig.3 shows the PC board assembly details. Begin by checking the PC board for any shorts or breaks in the copper tracks. Check also that the PC board fits neatly into the case. If it doesn't, file the corners and edges of the board so that it fits when seated on 6mm standoffs. These can be temporarily attached for testing the PC board fit. Position the assembled PC board within the box and mark out the four corner mounting holes.

Install the two wire links first, then the resistors. Note that the resistors marked with an asterisk are only used if the microphone needs an external supply. Table 1 shows the resistor colour codes used in the circuit. It is wise to check each value with a digital multimeter, as the colours can be hard to recognise.

The diodes can be installed next, making sure that D1 is the 1N5819. Be careful not to mix up the two zener diodes. ZD2 is the 5.1V zener and may be marked 1N4732 or C5V1. ZD1 is the 12V device and will be labelled 1N4742 or C12V.

Next, install the two ICs and the capacitors. Non-polarised capacitors can be installed either way around but standard electrolytics with negative lead markings must be placed in the PC board with the correct polarity.

The DC socket and REG1 can now be installed, followed by the PC stakes. The four pots can then be mounted on the PC board.

LED1 should be installed about 20mm above the PC board. It is later bent over to mount in a hole in the side of the case. Finally complete the PC board by installing the 9V-battery holder using three M2.5 screws. Make sure the leads are soldered to the PC board.

Drilling the box

Kit versions will probably be supplied with the case holes already drilled. If you're starting from scratch, the first job is to drill out the four corner mounting holes in bottom of the case to 3mm. That done, attach the four 6mm tapped spacers to the underside of the PC board using M3 x 6mm screws. **Note that the 6mm spacers must be nylon or insulated types to prevent the tracks on the PC board from shorting to the case.**

Next, mark out the positions for the pot shafts. The shaft centres are about 22mm above the outside base of the box. Drill the holes for the pot shafts, then use a rat-tail file to elongate the

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	2	100kΩ	brown black yellow brown	brown black black orange brown
❑	2	18kΩ	brown grey orange brown	brown grey black red brown
❑	2	12kΩ	brown red orange brown	brown red black red brown
❑	4	10kΩ	brown black orange brown	brown black black red brown
❑	3 (optional)	10kΩ	brown black orange brown	brown black black red brown
❑	2	3.3kΩ	orange orange red brown	orange orange black brown brown
❑	1	2.2kΩ	red red red brown	red red black brown brown
❑	7	1kΩ	brown black red brown	brown black black brown brown
❑	1	220Ω	red red brown brown	red red black black brown
❑	3	150Ω	brown green brown brown	brown green black black brown

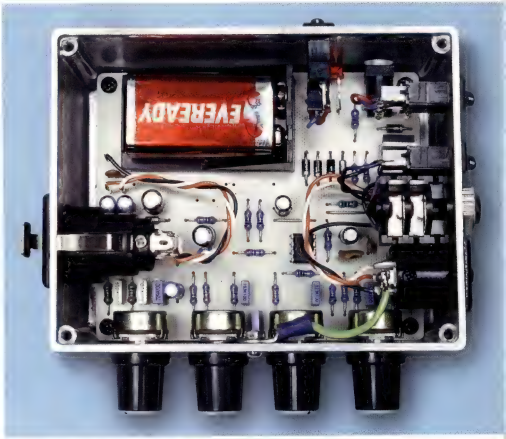
Table 2: Capacitor Codes

Value	µF Code	EIA Code	IEC Code
470nF	0.47µF	474	470n
220nF	0.22µF	224	220n
15nF	.015µF	153	15n
12nF	.012µF	123	12n
2.7nF	.0027µF	272	2n7
1.5nF	.0015µF	152	1n5
1nF	.001µF	102	1n
330pF	–	331	330p
220pF	–	221	220p
100pF	–	101	100p
22pF	–	22	22p

holes vertically. This will make it easier to insert the pots through the holes when the final assembly is inserted into the box.

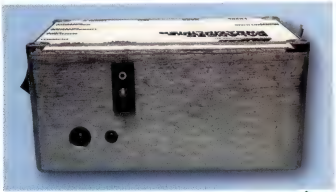
Now mark out and drill the mounting holes for the 6.35mm jack socket, the XLR connectors, the switches and the LED and DC socket. Use the front panel artwork as a guide to positioning these holes.

The switch cutout and XLR holes can be made by first drilling a series of holes around the outside perimeter, then knocking out the centrepiece and carefully filing to shape. The switches must be a snug fit so that they will be held correctly in position with the integral plastic retaining lugs. The XLR connectors are secured with M3 x 6mm screws that are tapped directly into the case. We used an M3 tap to make the thread and first drilled the hole out to 3/32" (2.4mm). If you use nuts instead of tapping the hole you will find it difficult to attach the lower nut unless it is glued in position first. Finally, drill a 3mm hole for the case earthing connection.

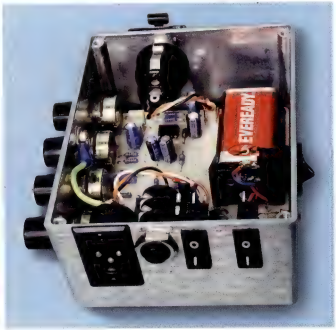


The PC board is secured to the bottom of the case using machine screws, nuts and spacers. All external wiring to the board is terminated using PC stakes. Note the earth wire between the case and pin 1 and shield terminals of CON3.

Now fit the PC board and secure it with M3 x 6mm screws. That done, mount the remaining hardware and complete the wiring as shown. The wiring to the the XLR connectors and switches is easier to install if they are not attached to the box but remember



Above: this view shows the location of the battery test switch (S3), the power socket (CON4) and the battery test indicator LED on the rear panel. Note that S3 should be a pushbutton switch, not a rocker type as shown here.



Right: this end of the case carries (from left to right) the 3-pin male XLR socket (CON3), a 6.5mm jack socket (CON2), the Ground Lift switch (S2) and the Power switch (S1). The 3-pin female XLR socket mounts on the other end of the case.

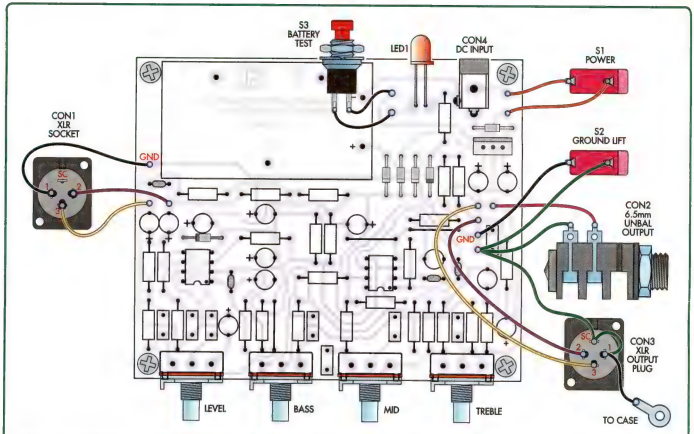


Fig.4: follow this wiring diagram to connect the external switches and sockets to the stakes on the PC board. Note that CON1 (balanced input) is a 3-pin female XLR socket, while CON3 (balanced output) is a 3-pin male XLR socket. The jack socket (CON2) provides the unbalanced signal output.

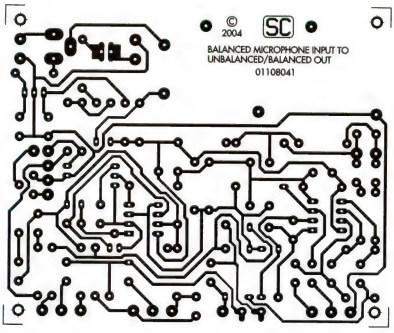


Fig.5: this is the full-size etching pattern for the PC board. Both the board pattern and a full-size front panel artwork can be downloaded from the SILICON CHIP website at www.siliconchip.com.au. Check your board carefully for etching defects before installing any of the parts.

to pass the leads through the holes in the case before soldering to the terminals. The connectors and switches can then be mounted in place after wiring.

The LED is inserted into its hole in the side of the box by bending its leads over and pushing it into position. Fit the panel label to the lid and install the knobs to complete the final assembly.

Testing

Apply power using a 9V battery and check that the battery test LED lights when the test switch is closed. Note that this LED will not operate if you are using a plugpack or phantom power. Test for 9V (when a fresh battery is powering the unit) or 12V when a plugpack is supplying power between pins 4 & 8 of IC1 & IC2.

Further testing can be done with a microphone and amplifier. Check the operation of the level control and the equaliser controls. The ground lift should only be used when there is a hum present in the signal. **SC**

ELECTRONICS

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August 2004

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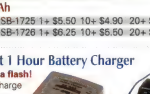

Cat. MB-3537 $69.95

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2.4GHz Wireless Audio Video Senders

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Send a signal from a DVD player, set-top box etc., to another room, without the use of any cables! You can use as many receivers as you like, without degrading signal quality. Each unit comes supplied with stereo audio and video transmitter and receiver, mains plugpacks, and RCA cables. Transmission range is up to 100m, but depends on the construction materials used.
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NEW KIT

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The Jaycar kit is supplied with genuine Belden RG58 A/V cable. This cable has a known, consistent propagation delay so you can be confident the propagation delay will be spot on. Beware of inferior kits that use cheap 'house' brand cable that might have wildly variable propagation delay characteristics.

KIT OF THE MONTH

KIT OF THE MONTH

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2.4GHz Portable Video Baby Monitor / Wireless Monitoring System

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Why not keep an eye on them as well? An integrated 45mm LCD allows you to see and hear your child. Camera features 6 IR LEDs for 'night vision', so you don't even need a light on. The applications of this system don't stop there however; you could use it for any remote monitoring application! Up to 3 cameras can be used with the receiver.

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Automotive Laptop Power Supply

Includes plug for Dell laptops!
Power your laptop on the go from a 11 - 16VDC source. It can provide 15, 16, 18, 19, 20VDC @ 6A, or 22, 24VDC @ 5A. Lightweight switchmode design, 5 plugs included.

NEW! 2004

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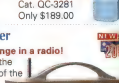
CD quality & dynamic range in a radio!
Be the first to experience the astonishing sound quality of the revolutionary new radio broadcasting system that makes FM and AM obsolete, Digital Audio Broadcasting. Not only that, you get all program information on the LCD screen - just like HDTV! Currently being broadcast on VHF Band III in Sydney and Melbourne on an experimental basis, you may be sure that the permanent system will operate on this band as it is internationally allocated. Radio supplied measures 250 x 160 x 90mm and has a retro style. Mains adaptor supplied but will work on 4 x D cells. Right and left RCA socket output on rear.
DUE LATE AUGUST



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Short range communication with mobile phones, PDAs, and more.

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Extend your reach almost 1 metre! Lightweight aluminium construction, suction cup ends, and a pistol grip.

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Four temperature settings between 29°C and 71°C allow you to set the ideal temperature to keep your drink at. Requires 12VDC.

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Your Grandmother won't like it, but you will!
It lets out a series of amusing sounds and lifts its head when you insert a pen into the rear-facing rectal receptacle.

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R-RATED!

Faraday Hand Powered Calculator

NEW! 2004

No flat batteries ever!
Shake the unit side to side to charge its internal battery. If it goes flat, just shake it again.

Cat. QM-7275
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How far is the next turn off?
Automatically convert a map's distance to real distance by rolling the small wheel along the desired route. It works with any map scale and displays in kilometres or miles.

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A great aid for draftsmen too!

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Incorrect tyre pressures can have adverse affects on handling and stopping distance. Keep check on your tyre pressures easily. 0 to 150PSI range.

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They can be used as wireless headphones with the transmitter, or tune into your favourite FM station when you go jogging.

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Soar to new heights of excitement!
This untethered flying saucer will soar into the air, while you maintain full control over its height. A small internal battery can be recharged on the landing base. Saucer dia. is 230mm.

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Electronic Dartboard

NEW! 2004

BULLSEYE!
Automatic scoring and sound effects make your dart game more enjoyable, and round finished darts make it safe. Measures 210 x 40 x 275mm.

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1W Luxeon LED Hand Torch

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Light up your night life!
Finished in a black aluminium case, powered from 3 x AA batteries. Wrist strap included.

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Strike back at remote control hogs!
This device jams most infrared signals used by TV, VCR, Hi Fi remotes, and more.

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A very versatile keyring attachment!
It operates as a great laser pointer, a UV LED torch, and a superbright white LED torch.

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Small, sleek, and stylish.
A unique rubber stand moulds to any shape to suit all surfaces. Clock face size is 81(H) x 55(W)mm.

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Spirit Level with Laser and Tripod

Make sure you keep a level head.
This spirit level has a line or dot laser to make long distance levelling a breeze.

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Digital Multifunction Sports Watch

Move over James Bond!
A clock, stopwatch, thermometer, and compass all in one! Calendar and alarm functions also included.

Cat. XC-0268
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Rechargeable batteries power the unit with an active charging stand supplied. Great if you have trouble manually removing corks. Stands 28cm high.

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Parabolic Microphone

NEW! 2004

Spy on a distant conversation!
Listen to birds from afar and more. You can look through the 10x monocular viewer, and record up to 12 seconds of sound.

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Projects the time on your wall or ceiling!
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Cat. QC-3192
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Quality four layer glass lens, with a maximum capacity of 104 photos. Measures 74 x 70 x 28mm excluding stand.
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Binoculars with 300k Digital Camera

Fantastic 8x zoom binoculars, with an integrated camera to take photographs from a distance.
Up to 100 seconds of video can also be recorded. Measures 110 x 90 x 46mm.
Was $74.95

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Cat. QC-3198
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Antibacterial Toothbrush Holder

A hygienic bathroom solution!
Ultraviolet rays sterilize your toothbrushes and razors etc, to stop the build up of potentially harmful bacteria. It helps remove odours, and can hold up to 4 toothbrushes and 1 razor at once.
DUE LATE AUGUST

NEW 2004

Cat. GH-1507
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Accessories not included

Alcohol Breath Tester with Readout

Drink Responsibly!
Dring driving is dangerous, and a crime. Keep an eye on your blood alcohol level. An LED scale displays your blood alcohol level between 0.00% and 0.1%.

The QM-7292 offers a good indication of blood alcohol, but should not be relied upon for precise results. Drink responsibly, and never drink and drive.

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1000 Foot Air Rocket and Launcher Set

The sky is the limit!
This air powered launcher uses a compressed air based propulsion system to launch the rockets high in the sky. It uses any heavy duty foot pump, or a 12V car pump which is (not included but commonly available).
Was $59.95

Buy a spare pack of Rockets and 60 Bursting Discs for just $19.95 Save $3.95!

SAVE $20

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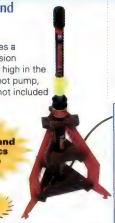

10 in 1 Office Multi-Tool

NEW 2004

The ultimate office companion!
It includes scissors, stapler, hole punch, carton opener, nail file, mini Phillips and slotted screwdrivers, and more.

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$24.95

Fishing Tool Set

NEW 2004

A must have for every recreational fisherman!
It includes a 14 in 1 multi tool, 0 - 6kg scales, and an LED hand torch, all in a convenient belt pouch.

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Cheap short distance communication!
Operating on standard 40 channel CB frequencies, they have a range up to 5km in an open field, and 1km in the city. Accessories available, see website for details.

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OR 2 FOR $85

Superbright 3W Luxeon LED Torch

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Super bright, super white!
Superior light output from a powerful Luxeon LED. It has a lens to focus or broaden the beam, strong aluminium body, and wrist strap included.

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Anti Fog Shave Mirror with FM Radio

Shave in the shower and save time!
A special layer on the mirror stops it from fogging up. It also has an FM radio to keep you entertained or up to date with the news. A splash-proof case protects the electronics from the odd splash of soapy water.

Cat. GH-1059
$29.95

The Amazing Flygun!

Keep the kids entertained!
The Amazing Flygun is a safe, fun, and effective method of killing flies and mosquitoes. Launch the spring powered swatter at your target! It is safe, fun, and really does work!

Cat. YS-5545
$9.95

Rechargeable Lithium Ion Digital Camera Battery Chargers

NEW 2004

Power your digital camera from rechargeable lithium ion (Li-Ion) batteries and save!
Lithium camera batteries are expensive and wasteful. Use rechargeable batteries and you will still be using them long after they have started saving you money. The chargers are powered from a mains plugpack or 12VDC cigarette lighter socket, and have LED charging indication. Batteries are not included, see below for batteries.

Product may differ from picture. Battery not included.

CR123A Li-Ion Charger
Cat. MB-3582
$44.95

CR-V3 Li-Ion Charger
Cat. MB-3584
$59.95

Rechargeable Lithium Ion Digital Camera Batteries

High quality Lithium Ion batteries for use in digital cameras and equipment.

CR123A
3.6VDC
600mAh
capacity.
Cat. SB-1740
$19.95

CR-V3
3.6VDC
1500mAh
capacity.
Cat. SB-1742
$29.95

The Ultimate Utility Tool

Includes belt pouch!
Tools include pliers, knives, bottle opener, screwdrivers, scissors, and much more.

Cat. TH-1907
$24.95

40 Pack AA Kingcell Batteries

Buy in bulk and SAVE!
These are high quality alkaline batteries, at almost half the price of small pack equivalents.
THAT'S UNDER 50c EACH!

Cat. SB-2332
$19.95

3kg Digital Nutrition Scales

Glycaemic Index (GI) calculation!
Keep track of the nutrition in your food. It displays the calories, kilojoules, cholesterol, protein, fat, carbohydrates and glycaemic index based on weight.

Cat. QM-7240
$79.95

1800 022 888
Freecall For Orders

Jaycar Gadgets

Vandal Resistant Dome Camera Housing

NEW 2004

Built like a tank!
No matter how sophisticated your surveillance system is, there is always the possibility of it being destroyed. This housing can withstand more than 500kg of pressure, and a blow from a 4.5kg sledge hammer. Suits standard board cameras.

Cat. QC-3328 $39.95

Microscope and Telescope Mounting Camera

Keep a video diary of your scientific discoveries and adventures!
The last thing you want is to discover or witness a momentary event, and have no record of it. These colour cameras will help you make sure that doesn't happen, and even take the eye strain away from looking through lenses by displaying the picture on a monitor. High quality CMOS colour sensors for excellent picture quality.

Telescope mount Cat. QC-3240 $189.00

Microscope mount Cat. QC-3242 $199.00

Water Resistant Pro Cameras with IR

NEW 2004

Superior quality and 0 LUX! High quality cameras inside water resistant housings.
They have 36 infrared LEDs and are powered from 24VAC. They are extremely versatile and have auto iris control, and accept C and CS mount lenses (available separately).

B&W 380 TV Lines
Cat. QC-3285 $299.00

Colour 480 TV Lines
Cat. QC-3287 $469.00

Vari-Focal Dome Cameras

NEW 2004

Superior flexibility!
Fitted with Auto-Iris Vari-Focal lenses, these cameras will suit a wide range of surveillance conditions, light sources, and more. They feature selectable backlighting compensation that adjusts according to light conditions.

B&W 380 TV Lines Cat. QC-3295 $279.00

Colour 480 TV Lines Cat. QC-3296 $369.00

Two Output Video Splitter

NEW 2004

Split signal without loss!
Share a live feed from a camera between a monitor and recorder etc and don't worry about any signal loss. Requires 12VDC or 24VAC power.

Cat. QC-3435 $49.95

IP / WEB BASED SURVEILLANCE

The simplest remote access surveillance around!
This relatively new technology uses some of the most user friendly operations we have seen. These devices can be assigned an IP address, which can then be accessed by anyone (with a password) within a local network, or the internet. They have an embedded Linux based web server, so they don't require a dedicated PC to operate, only for configuration purposes. The uses are limitless! They not only offer simple remote surveillance, they could be used for monitoring a child care centre, so parents could log on and see how their children are cared for, and much more.

IP / Web Based Camera

NEW 2004

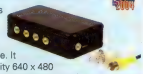
High quality 640 x 480 resolution images are broadcast to the world, or if you like, just the next room. The camera has a composite video out, selectable video quality, and the software offers such things as email alert on motion detection and more.

Cat. QC-3390 $349.00

IP / Web Based Video Capture Box

NEW 2004

Up to four channels of any composite video source such as cameras, video recorders, and more. It transmits high quality 640 x 480 images, with a local composite output also. Adjustable video quality, variable screen layout, and more.



Cat. QC-3392 $349.00

2.4GHz Wireless A/V USB Receiver

NEW 2004

Is this the simplest way to setup surveillance?
This USB receiver is compatible with the wireless cameras below. You can capture and view the signals with the composite video output for a TV, and it has an integrated USB output for connection to a PC. You can use up to 3 cameras at once, and the software supports motion sensing, remote access, scheduled recording, and much more. See website for details.

Cat. AR-1835 $249.00

2.4GHz Wireless Camera to suit AR-1835

NEW 2004

These are the same cameras that are used in the Baby Monitor (shown on page one) and really does simplify surveillance system setup. It features IR LEDs for 'night vision', audio, and measures just 110 x 65 x 55mm.

Cat. QC-3281 $189.00

4 Way Cat 5 Balun

NEW 2004

Long distance video cabling!
Use UTP Cat5 cable for transmitting video signals over distances up to 500 metres! Transmission range is dependent on cable and video type, and a Balun is required at each end.

Cat. QC-3427 $79.95

Video Signal Amplifiers

NEW 2004

Just a little boost!
Ideal for a range of transmission and surveillance applications, they feature on-board brightness and contrast controls to help ensure picture quality. Housed in an ABS enclosure, they have an integrated mounting flange, and require 12VDC power.

Single Channel Output
Cat. QC-3437 $69.95

Dual Channel Output
Cat. QC-3438 $79.95

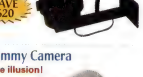
Rotating Metal Dummy Camera

Based on a real working rotating camera.
It pans back and forth, with maximum rotation angle adjustable.
Was $89.95

Cat. LA-5319 $69.95 SAVE $20

Heavy Duty Dummy Camera

A great surveillance illusion!
High quality construction and finish make this dummy camera look like top-of-the-line equipment.



Cat. LA-5313 $69.95

Vari-Focal Camera Lenses

NEW 2004

Simple adjustment of focus and zoom to expand the versatility of professional cameras. CS mount lenses.

3.5 - 8.0mm Cat. QC-3345
2.8 - 12mm Cat. QC-3347
6.0 - 60mm Cat. QC-3349

Cat. QC-3345 $79.00 | Cat. QC-3347 $99.00 | Cat. QC-3349 $169.00

Vari-Focal Auto-Iris Camera Lenses

Great flexibility when used in varying light conditions. Iris is automatically adjusted by the lens. CS mount lenses.

3.5 - 8.0mm Cat. QC-3350
2.8 - 12mm Cat. QC-3352
6.0 - 60mm Cat. QC-3354

Cat. QC-3350 $119.00 | Cat. QC-3352 $159.00 | Cat. QC-3354 $199.00

Zoom Camera Lens

NEW 2004

Ideal for a surveillance area with varying light conditions and objects of attention. Three built in motors allow control of focal length, focus, and iris. The motors are DC drive, and the lens is CS mount. 6.0 - 36.0mm focal length.

Cat. QC-3358 $299.00

Personal Paper & Media Shredder

Dispose of sensitive information for good! NEW 2004
Not only can you shred up to 15 pages at a time, it can also consume CDs, floppy disks, and credit cards with ease. Just pop them in and it's good- bye forever! A 15 litre bin takes care of the carnage.

Cat. YS-2830 **$129.95**

Manual CD Shredder

Destroy your information properly!
Render your old CDs unreadable. Simply insert your CD, wind the handle and steel rollers will cause irreparable damage to the disc. NEW 2004

Cat. YS-2832 **$39.95**

USB Magnifier Lamp

Utilise USB power and take the strain off your eyes.
A 50mm diameter glass lens provides great magnification while a built in lamp lights your work. NEW 2004

Cat. ST-2809 **$19.95**

GSM SIM Card Data Backup

Don't lose touch!
Make sure if you lose your phone, you don't lose your contacts. Simply insert the card, press 'backup', and it is stored! When you want to retrieve the data, insert the new card, press 'restore', and it's back! Couldn't be simpler! NEW 2004
Due Late August

Cat. XC-5375 **$19.95**

128MB 5 in 1 Digital Camera

Possibly the most versatile digital device around! NEW 2004
It measures just 72 x 17 x 15mm, but what you can't tell by looking at it, is that it actually has five different functions. It operates as a:
•300k pixel digital camera storing up to 2000 images.
•100k pixel digital video camera with up to 20 mins storage.
•Voice recorder with up to 2 hrs storage.
•Web camera when connected to a PC.
•128MB USB flash disk for data storage.
Powered by an internal lithium battery charged by the USB port.

Cat. QC-3224 **$299.00**

12 in 1 USB 2.0 Card Reader

Super fast data retrieval from your favourite media!
Supports most common media cards including XD.

Cat. XC-4853 **$59.95**

USB Phone Charger / Mini Massager

No flat batteries, no sore muscles!
Charge your mobile phone from your USB port, or ease away the stress of the day. It suits Nokia, Siemens, Samsung, and Sony Ericsson phones. NEW 2004
Due Late August

Cat. GG-2268 **$12.95**

USB 2.0 Video Capture Box

Streaming full resolution video on your PC!
Preview, record and playback video, or burn to CD or DVD. This is a great way of making DVDs if you own an analogue video camera. Includes capture and editing software, supports MPEG1 and MPEG 2.

Cat. QV-3090 **$99.00**

VGA to Video Converter

Play PC games on a TV!
This unit converts a VGA signal to a regular composite and S-Video output for display on a TV or projector etc. It displays on both the PC and TV simultaneously. USB powered, NTSC and PAL compatible.

Cat. XC-4870 **$99.95**

CD-R Labelling Kit

Professionally finished CDs!
Design, print, and apply labels to your burnt CDs. Pack supplied with 50 labels, application guide platform, and comprehensive design software. Extra labels available.

Cat. XC-4784 **$49.95**

3 Port Firewire PCI Card

Extremely fast data transfer.
The preferred medium for transferring digital video data, and for many external storage devices.

Cat. XC-4818 **$49.95**

4 Port USB PCI Card

Fast peripheral communication.
Don't mess around with slow speed transfer, use USB 2.0 for ultra fast 480mbps with plug n play compatibility. SAVE $5
Was $39.95

Cat. XC-4817 **$34.95**

10/100Mbps PCI Network Card

Share data with other computers in the home or office!
This card automatically senses network speed, and supports early transmit and receive interrupts.

Cat. YN-8062 **$13.95**

USB Wireless Security Lock

Simple PC security! NEW 2004
Here is a neat and easy way to protect your PC from prying eyes and intrusive fingers. You keep a small transmitter with you, and when you are out of range (around 2m) it puts your PC into 'lock mode'. When you return, it returns to normal operation. Transmitter, receiver, software and drivers supplied.
Due Late August

Cat. XC-4842 **$69.95**

USB Radio and Remote Control

Radio on your PC!
Receive, play, and record FM radio stations through an ultra-stable phase-locked-loop (PLL) tuning system for superior reception. Includes an IR remote control which can also be used with software such as MS PowerPoint.
Was $79.95

Cat. XC-4880 **$69.95** SAVE $10

High Quality 4 Speaker Multimedia System with Subwoofer

Superior sound for your music and games.
A remarkable sound from such a compact set of speakers. Bass, treble, and volume controls. 40WRMS total system power.

Cat. XC-5168 **$49.95**

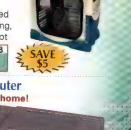
USB Powered Battery Charger

Recharge your batteries while you download your photos! NEW 2004
Why use another mains outlet when you can utilise the USB power at hand. Charge up to 4 x AA x AAA, Ni-MH or Ni-Cd batteries.

Cat. XC-4950 **$19.95**

Perspex Window Kit for ATX Cases

Mod your PC!
Create great effects with neon lights. LEDs and see them through this window. Supplied with all hardware for mounting, some tools required. Case not included.
Was $24.95



Cat. XC-4638 **$19.95** SAVE $5

4 Port Broadband Router

Share access through the home!
Connect up to 4 PCs to your fast internet connection. Great for households with multiple users! Incorporates LAN and WAN support, and an Integrated DHCP client for automatically obtaining configuration information from your ISP.

Cat. YN-8090 **$149.95**

Blade Fuses with Blown Indication

NEW! 2004

Quickly locate blown fuses!

An internal lamp illuminates as soon as the fuse blows, so there is no need to test them with a meter. They work with voltages up to 32VDC, so they are suitable for almost all automotive applications.

Type	Colour	Blade Fuses	Mini Blade Fuses
3A	Pink	Cat. SF-5000	Cat. SF-5050
5A	Orange	Cat. SF-5002	Cat. SF-5052
7.5A	Brown	Cat. SF-5004	Cat. SF-5054
10A	Red	Cat. SF-5006	Cat. SF-5056
15A	Blue	Cat. SF-5008	Cat. SF-5058
20A	Yellow	Cat. SF-5010	Cat. SF-5060
25A	Clear	Cat. SF-5012	Cat. SF-5062
30A	Green	Cat. SF-5014	Cat. SF-5064
		Blades (ea) $1.00	Mini Blades (ea) $1.25

In-Car Rechargeable LED Torch

Light up any situation!

Don't get caught without a torch. This unit charges from your cigarette lighter socket so you don't get stuck without batteries.

Cat. ST-3360 $24.95

Auto Voltage Meter / Thermometer

Keep informed on the road.

Keep an eye on your car battery voltage as well as inside and outside temperature. It includes a great blue Electroluminescent (EL) backlight and integrated clock.

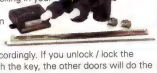
Was $39.95

SAVE $5 — Cat. XC-0116 $34.95

Power Door Locking Kits

A touch of luxury.

Install central locking in your car, and when you disarm / arm your alarm, the doors will unlock / lock accordingly. If you unlock / lock the drivers door with the key, the other doors will do the same also. Supplied with actuators, mounting hardware, control relay, and all wiring.



2 Door Cat. LR-8810 $29.95 — 4 Door Cat. LR-8812 $39.95

12VDC 19 LED Stop/Tail Light

Safety first!

A typical stop/tail lamp takes between 120-160 milliseconds to fully illuminate. This translates to over 4 metres at 100km/h. An LED stop/tail lamp illuminates instantly. The extra 4 metres may be the difference between a crash and a near miss.

NEW! 2004

Cat. ZD-0316 $14.95

Multi-Function Rear View Mirror

An in-car communications centre! Don't use your mobile phone in the car without a hands free unit.

This mirror clips onto your factory unit, and has an integrated hands free with speaker and earpiece, and a 60 second voice recorder (suits Nokia and Ericsson).

Was $89

SAVE $10 — Cat. GQ-2120 $79.00

Multi-Function Rear View Mirror with Reversing Sensor

Accurate reversing every time.

Reversing can be a hassle for many people, especially with large cars or 4WDs. This mirror contains the same features as the unit above, with the addition of a parking sensor so you don't have to guess how far away from objects you are.

Was $189

SAVE $20 — Cat. GQ-2122 $169.00

7" Widescreen Colour TFT LCD Monitor

Portable viewing pleasure!

This monitor delivers high resolution pictures with clear sound reproduction through its internal speaker. Powered directly from 12VDC, it can be used in a car, or powered from a mains plugpack. See website for details.

Was $399

SAVE $40 — Cat. QH-3752 $359.00

12VDC 12W Auto Work Light

Shed light on the situation!

It is powered from your cigarette lighter socket with a 4.5m lead.

NEW! 2004

Cat. ST-3032 $16.95

Car Washer Nozzles with LEDs

A touch of colour for your car.

Replace your washer nozzles with these units that are fitted with LEDs. Please note, illegal to use illuminated while vehicle is in motion.

Blue LEDs Cat. LA-5092 $9.95 — Tri-Colour LEDs Cat. LA-5094 $19.95

3 - 28V Wireless Auto Tester

Safe and easy voltage detection.

When positive voltage is detected, it will buzz, vibrate, and light up. It is safe to use with ECUs, air bags, and transducers etc.

Cat. QP-2212 $29.95

Neon Spark Plug Tester

Simple tester for a simple problem.

Don't get caught with a faulty spark plug. Bright neon illumination indicates spark presence.

Cat. QP-2264 $5.95

Dwell Tacho DMM

Multifunction automotive multimeter.

Measure RPM, resistance, up to 15ADC, dwell angle, and more. It also includes instructions on how to set certain engine parameters. A great meter to have around the workshop or garage.

Was $59.95

Cat. QH-1440 $49.95 — SAVE $10

SELF INSTALL CAR ALARMS - GREAT FEATURES AT A GREAT PRICE

Our great range of car alarms provide great features with fantastic value for money.

Economy Car Alarm

Great features, great price.

If you want no-nonsense protection for your car, then our economy model is for you. Features include anti-hijacking, auto rearming, immobiliser, and central locking control, just to name a few.

Was $119

SAVE $10 — Cat. LA-9000 $109.00

Full Feature Car Alarm

Backup battery siren for better protection.

A great alarm full of unique features, that still won't break the bank. Automatic arm / disarm function, panic alarm, code hopping remotes and more make this alarm great value for money.

Was $199

SAVE $20 — Cat. LA-9005 $179.00

Two Way Radio Paging Alarm

The ultimate alarm for automotive protection.

An LCD on the remote displays warns you of an alarm trigger and displays the point of entry as well. It will transmit up to 2km, so you can feel confident your car is safe. See website for details.

Was $349

SAVE $50 — Cat. LA-9010 $299.00

Jaycar Electronics

www.jaycar.com.au
Online Internet Ordering

NEW HARDCORE ELECTRONICS!

This section is dedicated to what's-new for the Hardcore Enthusiast.

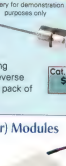
Carbon Monoxide Meter

Protect from the hazards of CO.
Carbon monoxide is a silent killer that can be generated by any household appliance running on gas or kerosene or heating oil and internal combustion engines. This meter detects concentrations as low as 1ppm up to 1000ppm with a 5% accuracy.

NEW! 2004

Cat. QM-1665 **$229.00**

GPO Mains and Earth Leakage Tester



Make GPO installation and checking a breeze!
Identifies problems with wiring, and checks earth leakage circuit breakers using selectable trip current. A must have for electricians and handymen.

NEW! 2004

Cat. QP-2000 **$19.95**

Magtrix Magnetic Connectors

Need to be seen to be believed!
Extremely versatile and provide a unique and reliable electrical connection that can disconnect and reconnect without fuss. Ideal for a myriad of projects where connecting and disconnecting power can be a problem. Reverse polarity conscious, sold as a pack of 3 matching pairs.

NEW! 2004

Cat. PP-0050 **$4.95**

LASCAR Remote Location Data Logger

Log periodical temperature measurements unassisted for up to one year in the field.
An internal lithium battery provides power, while an IP-67 rated enclosure protects from the elements. Logging rate can be set between every 10 seconds, and every 12 hours. Data is retrieved with a PC using the internal USB port.

Cat. QP-6012 **$149.00**

TDA 1905 5W Audio Amp IC BARGAIN

SCOOP PURCHASE!
It is a 5W audio amplifier with an internal muting facility. 16 DIP package, data sheets are available on our website.

NEW! 2004

Cat. ZL-3600 **$3.95** ea | Cat. ZL-3602 **$34.50** pk 10 | Cat. ZL-3604 **$200** pk 100

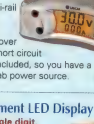
Economy Brand 1W LEDs

Cost effective alternative!
We believe our in-house brand economy LEDs are just as bright as the Luxeon counterparts at a much cheaper price. See website for data.

NEW! 2004

Red	**Cat. ZD-0410**	**$10.95**
Green	**Cat. ZD-0412**	**$12.95**
Blue	**Cat. ZD-0414**	**$12.95**
White	**Cat. ZD-0416**	**$12.95**

LASCAR 1.5V to 30VDC 1A Switchmode Lab Power Supply



Revolutionary variable switchmode design!
These units are stackable to provide a multi-rail power supply configuration. Over voltage, over current, and short circuit protection is included, so you have a reliable, safe lab power source.

NEW! 2004

Cat. MP-3095 **$199.00**

Blue 7 Segment LED Display

Cool blue single digit. Common cathode,
50mCd typical. See our website for data sheets.

NEW! 2004

Cat. ZD-1856 **$5.95**

SMD Vacuum Pick-Up Tool

The only way to handle SMD components!
Tweezers are clumsy. This device lets you latch on to the top of the device without harm. Especially handy for PLCC devices.

NEW! 2004

Cat. TH-1974 **$59.95**

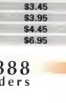
90 - 300VAC / DC Voltage Tester

A quick go / no go indication.
High quality insulated probes, neon indication.

NEW! 2004

Cat. QP-2240 **$3.95**

Thermoelectric (Peltier) Modules



Solid state heating and cooling.
These reliable thermoelectric devices cool to -27°C and heat to +64°C relative to ambient temperature. They require 12 - 15VDC, heatsinks, and fans depending on the application.

33W 4A Cat. ZP-9100 **$11.95**
54W 6A Cat. ZP-9102 **$14.95**
68W 8A Cat. ZP-9104 **$17.95**

Glue Impregnated Heatshrink

For waterproof and dustproof connections.
The glue inside the heatshrink releases as you shrink it creating a high quality seal.
1.2 metre lengths.

Dia	Cat	1+	4+	10+
3.2mm	**WH-5600**	**$2.95**	**$2.60**	**$2.30**
6.4mm	**WH-5602**	**$3.45**	**$3.05**	**$2.75**
7.9mm	**WH-5603**	**$3.95**	**$3.45**	**$3.15**
9.5mm	**WH-5604**	**$4.45**	**$3.95**	**$3.45**
12.7mm	**WH-5605**	**$4.95**	**$4.45**	**$3.90**
19.1mm	**WH-5606**	**$7.95**	**$6.95**	**$6.25**

3.6V Rechargeable Cordless Screwdriver

Take the strain out of your wrists.
Use our powered screwdriver and install or remove multiple screws with ease.
Was $19.95

Cat. TD-2495 **$14.95** SAVE $5

Ratchet Crimp Tool for Insulated Terminals

Heavy duty tool, lightweight price.
Don't use flimsy terminal crimpers, this unit has a ratchet mechanism and solid construction. The crimp die also has colour coded crimps for red, yellow, and blue.
Was $39.95

SAVE $5

Cat. TH-1829 **$34.95**

7" Stainless Steel Electrical Shears

Fantastic cutting power!
Suitable for use with electrical wire up to 22mm² and make light work of cable ties, heatshrink, light hook-up wire, and more. Quality insulated handles and a lock to keep them closed when not in use.
Was $12.95

SAVE $3

Cat. TH-1757 **$9.95**

Antistatic Soldering Station

High quality, great price!
If you want a fantastic soldering station that won't break the bank, the Goot is for you. It is ESD safe, has a digital temperature adjustment from 200 - 480°C at 65W, and a lightweight soldering pencil.

Cat. TS-1440 **$229.00**

60W SMD Soldering Tweezers

The best way to solder SMD.
Solder and desolder small components or large flat pack ICs. Tips available from 2 to 20mm. 2mm tips supplied.
Was $99.95

SAVE $15

Cat. TS-1700 **$84.95**

Soldering Iron Tip Conditioner

Keep your tips in top condition.
Just touch your hot tip into the tin. The flux cleans and the solder tins your tip at the same time.

Cat. TS-1512 **$6.50**

ELECTRONICS

RFID – Secure Access Without Keys!

NEW KIT

Radio Frequency Identity (RFID) is a contact-less method of controlling an event such as a door strike or alarm etc. An 'RFID Tag' transmits a unique code when energised by the receiver's magnetic field. As long as a pre-programmed tag is recognised by the receiver, access is granted.

RFID Security Module Receiver Kit

Ref: Silicon Chip June 2004.
Provides normally open, normally closed relay contacts. Supplied PCB will mount behind standard wall plate. Kit supplied with PCB, tag, and all electronic components.

Includes 1 Keyfob RFID tag worth $9.95 absolutely FREE! See below for extra tags.

Cat. KC-5393 $89.95

RFID Tags

These tags transmit a 40 bit unique code and are EM-4001 compliant. Two styles available:

Keyfob Style — Cat. ZZ-8950 $9.95

Credit Card Style — Cat. ZZ-8952 $5.95

Luxeon Star LED Driver Kit

Power 1W, 3W, and 5W Luxeon LEDs from a 12V source!

Ref: Silicon Chip May 2004. Save $$$ off purchasing pre-built drivers. Kit includes PCB, and all electronic components.

Cat. KC-5389 $29.95

Interior Light Delay Kit MkII

NEW KIT

A great modification for your car!

Ref: Silicon Chip June 2004. The new model interior light delay kit features a great fade out effect, and simplified wiring, even when used with modern cars. Kit includes PCB, case, and all electronic components.

Cat. KC-5392 $18.95

Micrometter Stereo FM Transmitter Kit

Transmit quality audio to your FM stereo!

Ref: Silicon Chip Dec '02. This project features a quality surface mount BH1417F processor, and is crystal locked to a pre-selected frequency to eliminate frequency drift. Kit includes PCB, case, silk screened front panel, and all electronic components.

Cat. KC-5341 $49.95

Digital Fuel Mixture Display Kit

Numeric and bargraph readout!

Ref: Silicon Chip Sept/Oct 2000. Keep an eye on your car's air/fuel ratio in real time. Works between 11.8 and 20.6 for petrol, 12.7 - 21.5 for LPG. Kit includes PCBs, case, pre programmed PIC micro, hook up wire, and all electronic components.

Cat. KC-5300 $62.95

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Take photos like a professional!

Ref: Silicon Chip July 2003. Not only does this project trigger a slave flash unit, it can be configured to account for multiple flash red-eye reduction systems too. Kit supplied with PCB, case, silk screened panel, and all electronic components.

Cat. KC-5364 $22.95

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Ref: Silicon Chip June 1997. Control motor speed, dim headlights, run 12VDC motors from 24VDC and more! With the addition of a single MOSFET, it will handle 20A. Kit includes PCB and all electronic components to build the 10 amp version.

Cat. KC-5225 $23.95

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Ref: Silicon Chip June 2004. Movie companies deliberately tamper with the video signal to restrict copying, but this robs you of the true high quality picture your system is capable of and you deserve. Get the picture you paid for and strip out these annoying signals, including Macrovision, by connecting our Doctor Video Kit inline with your DVD player or VCR. Kit supports S-Video and composite video signals. Case, circuit board, electronic components and comprehensive assembly instructions are supplied.

Cat. KC-5390 $99.95

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Component Video to RGB Converter Kit

Superior video quality!

Ref: Silicon Chip May 2004. The super high quality of Component video is the best on offer, but what if your projector or plasma TV etc only has RGB inputs? This unit converts the Component signal to RGB format with minimal signal degradation. Kit supplied with PCB, case, silk-screened and punched panels, colour coded RCA sockets, 9VAC plugpack and all electronic components.

Cat. KC-5388 $99.95

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Ref: Silicon Chip Nov 2001. Wire all the rooms in your house to source devices such as DVD players, VCRs, and cable television without any loss in signal quality. It is also ideal for presentations on multiple monitors, or you could use only the audio distribution and wire audio to all point in your house! Kit supplied with PCB, case, silk screened and punched panels, and all electronic components.

Cat. KC-5320 $139.95

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Remote Control Extender Kit MkII

A simple AV solution.

Ref: Silicon Chip July 1996. Add remote control ability to rooms with wired AV via a two-wire cable. Kit supplied with PCB, case, and all electronic components.

Cat. KC-5209 $22.95

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Transmit AV signals to your TV!

Ref: Silicon Chip July 1999. It transmits to your TV onto channel 0 or 1 up to 20 metres. Kit supplied with PCB, case, antenna, and all electronic components.

Cat. KC-5272 $42.95

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PRODUCT SHOWCASE

MicroZed's Project Board for Big PICAXEs

With the enormous popularity of PICAXE chips for experimenters (not the least due to Stan Swan's articles in SILICON CHIP, which will return soon!), MicroZed, Australian distributors of PICAXEs, have released a project board suitable for 28 to 40-pin chips, to make experimenting with the larger PICAXE chips really convenient.

The PC board comes from Revolution Electronics in the UK (the makers of PICAXE) and is highly suitable for development or even one-of-project work. MicroZed adds the extra bits to make it even more versatile, including along a 4.5V battery box, a programming socket, three resonators (4, 8 and 16MHz – you can program at one speed and run at a faster speed) and more.

At time of going to press, no price details were available but MicroZed

have assured us that all relevant information will be available on their website as soon as it is received from the UK.

Contact:
MicroZed
PO Box 634, Armidale NSW 2350
Tel: (02) 6772 2777 **Fax:** (02) 6772 8987
Website: www.microzed.com.au

New SILICON CHIP kits from Jaycar, DSE

Jaycar Electronics and Dick Smith Electronics recently submitted their versions of recently published SILICON CHIP designs for our evaluation.

Jaycar's kit is for the Component Video to RGB Converter (Silicon Chip May 2004). The design of the electronics has not changed from the publication but for ease of construction (and fewer problems) it includes a double sided PC board that has plated-through holes. The kit is housed in a quality ABS plastic instrument case with silkscreened and laser cut panels, along with the colour coded RCA sockets of the original design. A 9V plugpack is included.

The kit is now available in all Jaycar stores. With a catalog number KC-5388, it retails for $99.95

Contact:
Jaycar Electronics
PO Box 6424, Silverwater NSW 1811.
Tel: 1800 022 888 **Fax:** (02) 9741 8500
Website: www.jaycar.com.au

The DSE kit department were very quick off the mark with their version

of the SILICON CHIP Energy Meter, the second article of which only appears in this issue.

Their kit is housed in a more traditional "instrument" case than was the original and has a silk-screened front panel, making it look very smart indeed.

The kit, Cat K-7217 sells for $127.00 and will be available in all DSE/PowerHouse stores, via mail or web order from the end of August.

Contact:
Dick Smith Electronics (all stores)
Reply Paid 500, PO Box 500,
Regents Park DC NSW 2143.
Tel: 1300 366 644 **Fax:** (02) 9642 9155
Website: www.dse.com.au

Versatile LogBox Data Logger

The LogBox datalogger accepts several analog industrial sensors and accurately records the measurements in non-volatile memory. Setup and data retrieval is done in a PC via an infrared wand through the use of LOG CHART, Windows-compatible software which plots and prints graphs, lists loggings and exports data to spreadsheets. Special mathematical functions can be programmed.

The 64x58x35mm logger has two universal multi-sensor channels with 0-50mV range. Accuracy is 0.15% of full scale, while capacity is 8111 measurements/channel. Recording rate is from 0.5s to 30 days and its internal real-time clock is compliant to 2080. The unit is powered by an internal 3.6V lithium battery, with a life of 1250 days (logging every 30s) or 560 days (logging every 5s). A LogBox pulse counter and logger is also available.

LogBoxes are very economically priced and are being used for research, monitoring and control purposes in private companies and public organisations, universities and colleges around the world.

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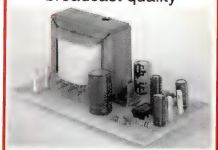

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On the 'net? Make free phone calls, courtesy of MicroGram!

Aren't overseas or long distance phone calls expensive?

How would you like to make those calls free? Talk for as long as you like? And never get another long distance phone bill again?

Sounds impossible? We thought so – which is why we took a second look at MicroGram's USB NetPhone.

OK, so (at the moment) there are a couple of caveats. You need to be on the 'net, as does the person you want to talk to (at least for free calls). If you're on broadband, from there on it's completely free of charge. (Dial-up, naturally, means a local phone call charge to log on. And you will be logging up minutes/hours depending on your ISP plan).

We're not just talking home (fixed) phones – this USB Phone is a perfect solution for home, SOHO and travelling users. Quality of calls is significantly better than normal phone-to-phone calls.

It simply installs as an additional audio playback and recording device on any USB port. MicroGram recommends using "Skype" (**www.skype.com**) which at the moment is a free download; other programs like MSN Messenger, NetMeeting, Yahoo Messenger, and ICQ are also compatible.

It is also possible to call standard phones from your NetPhone. However, this requires a subscription to a service such as **freetalk1.avoip.com** (Skype is now offering this feature as well [called "Skypeout"] but it is still in beta format and apparently has not yet been officially launched).

As we said, PC to PC calls are free; PC to phone call rates to the most popular countries (eg, UK, USA, NZ, etc, are about a tenth of standard rates (ie, about 2c/minute) .

We plan on looking at this whole netphone communication area shortly in SILICON CHIP – but in the meantime, grab a yourself a MicroGram USB phone (rrp $89.00), plug it in, download the software . . . and start talking!

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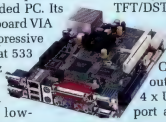
Ideal for control and multimedia applications, and products such as kiosks & POS, the EM-660A, a 5.25" form factor, multimedia capable and network ready embedded PC. Its low power fanless on-board VIA Eden CPU provides impressive performance running at 533 MHz with a 133MHz FSB.



It is supplied with the VIA Eden/Ezra low-power 1.8V CPU, running at 533MHz with up to a total of 512MB SDRAM.

The integrated S3 ProSavage 4, AGP 4X graphics support VGA, 36 bit TFT/DSTN/STN LCD panels and 2 channels of 18 bit (2x18) LVDS. On board audio provides line-in, mic-in, CD-in, line-out & speaker-out connectors. 10/100 LAN, 4 x USB, 1 multimode parallel port and 4x serial ports (three RS232, one RS232/422/485) are all provided standard.

The EM-660A also provides floppy disk and hard disk support and watchdog timer. Expansion is possible with PC-104 and PCI slots.

Contact:
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First fibre-to-the-premises installation for Sanctuary Cove homes

Wave7Optics and Delfcam, the network installer and operator, have won the contract to install a FTTP (fibre-to-the-premises) network in the prestigious Sanctuary Cove residential development, on Australia's Gold Coast, 45 minutes from Brisbane.

The two companies expect to connect more than 1500 homes by the end of 2006. The initial phase, which has already begun, consists of 130 homes, at about $1950 per home.

Sanctuary Cove, Australia's first fully integrated residential resort. will be one of the the first Australian developments of its kind to provide FTTP-based services.

It will use the Last Mile Link to offer digital video, including local free-to-air, cable and satellite television channels, video-on-demand services, wi-fi hotspots, the highest-speed Internet service in the country, multiple telephone lines per residence, a community intercom and security system featuring closed-circuit television and gate access control, and home automation services. **SC**

SERVICEMAN'S LOG

Pipe locators, models & old crows

With the price of domestic electronics equipment plunging ever lower and lower, I have had to diversify into other fields of electronics – where people are prepared to pay for repairs. As a result, I get to repair some rather unusual equipment.

ONE INTERESTING DEVICE I was recently asked to fix was a commercial pipe locator, as used by local councils. This consisted of a 33kHz/8kHz transmitter and a radio detection wand receiver. This device basically looks for signal induction in pipes, as well as in power cables.

The only trouble was that this particular unit didn't want to oscillate. As I quickly discovered, the unit is supplied by a 5V source but this had dropped some 20% to 4V. But although being a helpful clue, the question was whether the power supply itself was faulty (and so couldn't deliver the power required) or was it the load that was giving problems and dragging the supply down?

A cursory inspection of the AC/DC power supply didn't reveal any clues and the circuit diagram supplied was a nightmare to interpret. Anyway, I decided to first check the load option and began by disconnecting the 5V rail to each of 20 ICs (by breaking the Vcc track). When I did this, the 5V rail gradually recovered as I disconnected more and more of the ICs, as you would expect. However, one IC that was isolated had a dramatic effect, with the rail jumping by nearly the full volt!

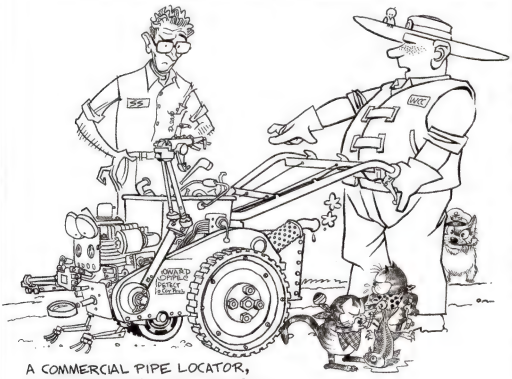
Delirious with joy, I ordered the IC and when it came, I couldn't wait to install it. However, it made no difference! Bummer!

I had isolated this particular IC by removing a jumper link but on inspecting the double-sided board more closely, I noticed there were some surface mounted capacitors on the same rail. These were all found to be resistive and it turned out that it was these components that were causing the 5V rail to drop to a level where the oscillator wouldn't work.

I removed one of these capacitors and measured it out of circuit but could find nothing wrong with it. I then did the same with eight other surface-mounted capacitors which were hung off the 5V rail and again none measured faulty. However, the unit was now working.

So what gives? Well, it took a little while for the bell to toll for this idiot (I must be an idiot to work in this profession!). It was actually the cement (or glue) that was used to fit these surface mounted components to the board prior to soldering that had become conductive. Desoldering and removing the components had also melted or destroyed the glue link, so the circuit came good.

Cleaning the board and refitting the capacitors restored the unit to full working order.



The old turntable

The Technics SP-10MkII-XAL is a professional quartz phase-locked direct-drive turntable which, I believe, cost about $4500 20 years ago – and the tone arm was extra! As a matter of interest, its claimed speed drift was within 0.002%!

The one that came into the workshop was, I was told, an ex-ABC unit. And it had an unusual fault – when switched on, the turntable would sometimes go backwards! Still, that's ideal for Rap music, in my opinion.

Items Covered This Month

- Pipe locator
- Technics SP-10MkII-XAL direct drive turntable
- Akai VS-G875EA-D VCR
- Philips 21PT2302/79R TV set (L01.1A chassis)
- Philips 900 series TV set (KS685 KL9A-3 chassis)
- PanasonicTX-86PW100A widescreen TV set
- Nakamichi Soundspace SS-11 home theatre system
- Teac EU-68ST-1 TV set employing an 11AK37 chassis.

These decks use an external power supply (SH-10E) in a separate box, the connection being via a Cannon plug which supplies +5V, +32.5V and 140V DC. The owner had managed to borrow another power supply and the deck worked flawlessly with this. However, when I measured the three DC outputs of the original supply, they were all approximately correct under no-load conditions.

Even so, there was obviously a problem with this power supply.

My next step was to compare the two supplies more thoroughly and I soon found that the good supply was 10V higher than the faulty one on the 140V rail. However, both supplies were high on this rail, the rail measuring +156.3V on the faulty unit and +163.2V on the good unit.

It didn't take long to find that C416 (100µF, 160V) was open circuit in the crook supply. I replaced this, along with a 22µF capacitor on the same rail for good measure. Now both supplies mirrored each other for the 140V output but to my disgust, the fault was still there!

Because the turntable was going intermittently backwards, I figured that this had to be a logic problem and therefore the 5V rail was probably the culprit. Under load, it was dropping to 4.6V, so I investigated this further.

A few quick checks revealed the the collector voltage of regulating power transistor TR404 was incorrect. It should have been at 11V but was down to 9V. I replaced capacitor C410 (1000µF, 16V) which restored the 11V collector voltage and after adjusting R406, I now had a precise 5V output on load.

This cured the fault and I found that C410 had indeed dropped its value. Finally, I replaced the pilot lamp and gave it a good soak testing, just to be on the safe side.

Warranty claims

On the TV front, there have been a lot of warranty claims for consumer related issues. Apart from the lack of height, which I have mentioned before regarding letterbox/16:9 transmissions, we now get a lot complaints for poor sound and incorrect colours on brand new TVs, whether they be from terrestrial broadcasts or AV inputs. Almost all such problems are attributable to incorrect selection of the television system for Australia.

We are CCIR (Comite Consultatif International des Radio-Communications (International Radio Consultative Committee)) System B/G ("B" being for television channels Band I/II and III) and "G" for German UHF channels. Our colour system is PAL-D and our sound system is 5.5MHz and 5.74MHz for stereo.

Another problem is language. If this is set to Chinese, Korean or Japanese, it's pretty difficult to work out how to put it back to English without a concise instruction booklet explaining the menu system.

Perhaps the manufacturers should universally come up with a common colour code for various menu settings – eg, Australia B/G PAL-D, 5.5, English all in red. Or perhaps you could just select the country or city you are in and the set will automatically select the correct system.

Back to the races

My next job was an Akai VS-G875EA-D VCR which had noise bars at the top of the picture.

I had sold this hifi VCR to a bookie back in 1998 and it had been in almost constant use recording horse races! Apparently, he used the on-screen real-time clock for timing the horses.

Because it had seen so much use, I automatically concluded that the video heads were worn when the noise bars were mentioned. Unfortunately, you can't buy the heads by themselves – instead, you have to get the upper and lower drum assemblies (including the motor).

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THE BOOKIE'S VCR

Enfield Electronics said they could obtain these parts in about four weeks and I was about to send a confirmation fax for the order when I noticed that the supply guide wasn't engaging fully home on the lefthand side around the head drum. Examining it carefully, I found some white plastic – presumably from a broken cassette – that had got caught on the grease. Removing it enabled the auto tracking to tune out the noise bars.

Unreasonable customer

Sometimes clients with warranty claims can be unreasonable.

We had one lady with the same model Philips TV who also complained of a faulty AV input and that her son couldn't play his video games, there being no sound or picture.

She demanded we call out immediately and bring a loan TV. Despite her obvious attitude problem, we could handle all this but I began to get tetchy when she gave me the wrong address for her home and I had to walk a long way with a loan TV to get to it.

She was in no mood to demonstrate the fault but I gently insisted that I had to see what was going on.

She had bought one of those 80 games-in-one units advertised on TV and had correctly connected it to the AVR input on the back of the TV, which she selected with the remote. However, when she switched on the video game, she put the card in back to front. I pointed this out to her, whereupon she proceeded to argue that she knew exactly how to use this game and she was doing it correctly and I knew nothing.

Well, what can you do? Fortunately the phone rang and she left the room to answer it, giving me the chance to turn the game around and plug it in correctly. When she returned, I already had the game running with sound, picture, colour lights and action.

She demanded to know how I had fixed it so quickly, so I gladly enlightened her. She took this with particularly bad grace and then refused to pay for the service call.

In the end, I just picked up the loan set and hiked back to the car. The old crow wasn't worth arguing with and I certainly won't be going back there again.

A sickly Philips

A Philips 21PT2302/79R TV set using an L01.1A chassis came in with an intermittent "no sound" fault and poor picture and colour on AV2.

I started by checking whether the correct Australian TV system had been selected and checked the option codes for the set. They were all OK. What's more, in the SAM mode, there were no fault codes in the error buffer.

I started with the sound problem and, using an audio probe, traced the TV sound all the way to the AV switching IC (IC7801 HEF4052BT), a surface-mounted 16-pin device. I also checked the Vdd voltage on pin 16 to find it was very low and traced that back to R3801 220Ω which is fed from the 8V rail, which was correct.

Fitting a new IC fixed the sound and I thought that if I also changed IC7802 (HEF4053BT), it might fix the picture too as it is such a similar switching IC. Unfortunately, changing it made no difference so that theory quickly bit the dust.

From here on, it looked as though it might get tricky. However, my hunch was that EEPROM IC7602 might have become scrambled, so I changed that as well as it's such an easy job (only eight pins and not even surface mounted!).

That proved to be a good move as it fixed the AV2 picture problem. I then checked and reset the options where necessary, before soak-testing the set and releasing it.

How or why the faults occurred is difficult to comprehend – perhaps there was a power surge in a storm that scrambled the memory and AV switch.

Lightning strikes thrice

I recently had a 1985 Philips 900 series KS685 with a KL9A-3 chassis come in to the workshop. It had suffered from a power surge during a storm and now had three distinct faults.

First, the TV/AV switch on the front panel wouldn't switch to AV video. Second, there was distorted sound on mono transmissions. And third, the yellow "Bilingual" LED was on all the time.

The TV/AV switch is a slide switch that indirectly connects 12V to pin 12 of IC7068 (HEF4066). The IC had been damaged and replacing this common analog device soon fixed that problem.

The second problem wasn't so easy to track down but eventually, by a process of elimination, it turned out to be the stereo decoder IC (IC7791, TDA2795). This IC also controlled the yellow "Bilingual" LED and replacing it fixed both problems.

Interestingly, the two ICs that were replaced are on different boards and these are in different locations inside the set. However, they were the only components damaged during the storm.

Panasonic widescreen TV

I was asked to do a service call on a Panasonic TX-86PW100A widescreen TV set which uses a EURO TauGIGA chassis and an 86cm picture tube.

The set was dead after a power surge and I really didn't think there would be much chance of repairing it in the customer's home. These sets are quite complex and if the Digital Board is damaged, the repair job can be an expensive exercise. However, I decided to give it a go in the home because of its weight (86kg) and size (65 x 93 x 59cm), along with its location on the second floor.

When the power to the set was switched on, the indicator LED briefly came on and then went off again. Apart from that, there were no other signs of life.

It's not easy doing service work on a large, complex set in a confined space. However, I soon managed to establish that there was +5V standby on TPD8 but no ±20V, +14V or +144V from the power supply. Nor could I get +376V on TPD6 to the primary of the switchmode power supply.

There was, however, 240V AC from TPD1, D2 to TPD3 and D4, which only left the bridge rectifier (D802). The bridge measured OK and it was R801 (2.7Ω) which connected the negative to ground that had been destroyed – and quite violently. I looked around but couldn't find any other shorts or problems that might have been associated with this destruction.

As I didn't have the correct resistor in my toolbox, I hung a 2.2Ω 10W resistor onto the remainder of the original resistor using crocodile clips. I was expecting this substitute to explode just as violently as the original when I switched it on but it didn't. Instead the set came on, apparently no worse for wear.

In the end, I had to go back to the workshop for the correct part but both the client and I were both happy that it turned out to be so straightforward.

Speaka da Nakimichi?

My mate Pete speaks pretty good Nakamichi for an Aussie. However, after his 5-day nightmare escapade with a 2-year old $18,000 Soundspace SS-11 home theatre system, he is thinking of taking up Hungarian. This system had been struck by lightning and was for all intents and purposes dead except for the Standby LED flashing.

Pete spend day 1 disassembling the thing and trying to figure out how it was supposed to work. Initially, for the

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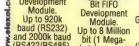

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DEATH IN A TURKISH TEAC

main relay to switch on, there are a series of 5V rails that have to be OK. These are controlled by a CPU via a 15-pin cable and a digital sound and video processor unit.

Initially, there was no +5V rail due to the $1400 DSB board blowing up. After this had been replaced, the second 5V rail was low. Peter wasn't sure about the central control unit and had to arrange with the agents to borrow one to check this one out. As it happened, it was OK but he found parts of the power supply had blown – in particular, Q407, Q406 and Q408, as well as U403.

Next, he had to sort out 5V rail No.3 and he traced this to a small regulator (U402) on the headphone amplifier heatsink. Unfortunately, none of this was easy as the component layout diagram is split over a number of boards.

With all the rails now correct, the system would then switch on properly. Finally, he had to reassemble it all and test it. On the sixth day he resteth and so endeth this story.

Dead Teac

I recently had to deal with a 2002 Turkish-built Teac EU-68ST-1 TV set employing an 11AK37 chassis. This set was dead with no power and I found that FET Q801 (MTP6N60E) and two diodes – D893 & D892 – had been destroyed. I replaced these, along with the control IC (IC800, MC44608), but the supply still wouldn't power up.

I spent a very long time checking out the rest of the circuit before concluding it must be the chopper transformer (TR802) itself. I placed an order for a new one only to be told I was going to be in for a bit of a wait.

The delay wasn't all that welcome, so I decided to take another look at the set and it was then that I noticed a tiny spark on the secondary winding.

I removed the transformer and found a wire going along underneath it which had been shorting against one of the pins. I isolated this, then replaced the transformer and tried again. The set fired up perfectly!

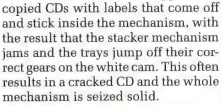
CD stacker adventures

Paul is a all-round good guy and a highly qualified audio technician whose chief mission in life is to repair CD stackers for cars. It is his job to repair the very popular OEM Matsushita 6-Disc In-Dash Changer Assembly (CQEF7080) CD mechanisms that fit in Mazda, Toyota and Subaru cars, to name but a few car manufacturers.

Just because he repairs so many of these does not mean they are a poorly designed mechanism. Their failure rate is just 0.0028% world wide. Instead, there are other reasons for the failures.

On many occasions, just to appease customers, car dealers have attempted to recover CDs that are "stuck" inside the machine and have ended up ruining the mechanism and PC board. As a result, the entire unit, worth about $1500, has had to be written off.

It's the CDs which often cause the trouble. What happens is that when the vehicle goes over a very rough surface and the unit is banged or bumped while changing discs, the CDs are jolted out of position and are not inserted correctly in the trays of the mechanism. This can also happen with copied CDs with labels that come off and stick inside the mechanism, with the result that the stacker mechanism jams and the trays jump off their correct gears on the white cam. This often results in a cracked CD and the whole mechanism is seized solid.


The Matsushita 6-Disc In-Dash Changer Assembly mechanism has no less than 371 moving parts. The black CD trays can be seen in the unit at right.

The dismantled Sony Trinitron tube. Note the round burn mark on the shadow mask.

It's Paul's job to strip down and realign the gears and trays, clean and replace any broken parts, reassemble and test. Sound easy? Well, check out the accompanying photo. You can just see the misaligned black trays on the righthand side. There are in fact 371 moving parts and the device is worth about $500 to buy!

Inside a picture tube

Ever wondered what the inside of a picture tube really looks like?

Taking into account the picture size, Sony Trinitron picture tubes are probably the heaviest of all the cathode ray tubes manufactured. And recently, we got the chance to look inside one.

It all came about when a Sony TV set came in with a purity problem on the lefthand side of the screen which couldn't be corrected. As a result, the tube was replaced under warranty.

As business was fairly quiet that day, rather than simply smash the tube and throw it away, we decided to carefully dismantle it and remove and examine the shadow mask to see why the purity was out. This revealed round burn/scorch marks on either side of the Trinitron strip shadow mask (see photo), one being much larger than the other.

Just how this happened is unknown as the client probably wouldn't admit to what happened. However, it looks as though an intense amount of energy from say a large white dot on a black background caused the shadow mask to distort, giving rise to the purity problems. The reason why the circle is smaller on one side than the other is presumably due to the energy absorption of the shadow mask strips.

The things some people do to TV sets! SC

POWERFUL DC MOTORS / GENERATORS: The 200W motors are the same motors as used in our scooters. The 300W motors are identical in size to the 200W but should not be used as replacement motors for the scooters as there is a 200W limit in most Australian states. They are very powerful for there small size and although they are built for 24V use, they still produce lots of torque at 12V. They start rotating at only 0.5VDC (yes 1/2 of a volt). We discovered that these motors would make great generators . When the 200W and 300W motors were driven at a low speed with a cordless drill they produced roughly the same results: 6V open circuit, 5V @ 5A and 4V @ 8A; the 100W motors were not tested. Our freight costs to most Australian capitals on these motors will be very reasonable.

SC100 (NEW) 100W DC MOTOR: 100W output as used in our small scooter. 24VDC operation Rated speed: 2300 RPM Rated current: 6.0A Measures: 67mm X 97mm (+ shaft) Shaft: 8mm "D" shaped end with cir-clip groove. Weight: Approx. 1.1kg. $22

SC200 (NEW) 200W DC MOTOR: 200W output as used in our large scooter. 4 brush, 4 magnet, 16 pole. 11 tooth chain sprocket to suit a chain pitch around 7mm. Double ball bearing for long life. Mounting bracket with 4 treaded holes 6mm X 1mm (M6). 24VDC, 11.0A 2750 RPM, 100mm Dia. X 80mm L (+ shaft) Shaft: 27mm X 8mm (8mm x 1.25mm (M8) LEFT HAND THREAD end) 2kg. $30

SC300 (NEW) 300W DC MOTOR: 300W output. 4 brush, 4 magnet, 16 pole. 11 tooth chain sprocket to suit a chain pitch around 7mm. Double ball bearing for long life. Mounting bracket with 4 treaded holes 6mm X 1mm (M6) 24VDC, 16.4A, 2650 RPM, 100mm Dia. x 80mm L (+ shaft) Shaft: 27mm x 8mm (8mm x 1.25mm (M8) RIGHT HAND THREAD end) 2kg.

100W SCOOTER REAR DRIVE PARTS

These are the drive components from our 100W scooter including the motor, toothed belt, pullies & rear wheel/ axle assembly. Ideal for robotics projects (SCD1) $28

(NEW) 12V / 24V CHARGERS:

These are serious chargers & will charge at a fast rate slowly reducing the current with the increase in charge but should not be left charging indefinitely. Charging figures from a quick test were 2.5A charge @ 11V, 2A charge @ 12.4V and 0.4A charge @ 14.9V. These chargers are 118mm L X 66mm H X 84mm W and weigh 1.4Kg. In side they have a 3300uF cap and what seems to be a 5A bridge rectifier and have Australian approvals.

12VDC CHARGER:
240VAC - 12VDC @ 2300mA: (SCC12) $17

24VDC CHARGER:
240VAC - 24VDC @ 1300mA: (SCC24) $17

PB12 (NEW) 12V / 12AH GELL CELL BATTERY: These batteries measure 150mm L X 94mm H X 95mm W and weigh approx. 4.100g. If you are looking for a charger check out our (SCC12) and (SCC24) mains powered chargers.

SPEED CONTROLLERS

Speed controller modules for the 24V motors we stock . They come with a connecting diagram. Only 7 wires are used for the speed controller function: Battery, Motor & 3 wires for the speed control potentiometer. These units require a 4K7 or 5K pot & a 2k7 resistor (not supplied) to take the place of the original throttle. Optional connections are for auxiliary circuits etc.. We don't supply any additional connectors.

Modules easily come apart & the terminals can be easily be soldered to.

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CONTROLLER (SPC350) UP TO 350W/24V MOTORS: $24

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$49. We have a limited number of Print Heads/ Cartridges. The optional Scanner Heads available only with a printer purchase.

DIGITALK HAND-HELD 40CH TRANSCEIVER: (NEW) Digitalk SP3380D, 40 Channel UHF CB Personal Mobile Radio, requires four AAA batteries (not supplied).Features inc. Up to 5k Range, Backlight LCD Display, Electronic Power On/Off, Menu Function, 40 channel scan & call alert, key lock function, Battery low indicator, external Mic/Ear Jack Output, Removable Belt Clip, Dual Watch, Stop Watch, VOX (only with optional Headset), Duplex, Buy 2 or more for $35ea $39ea.

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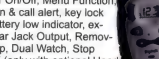

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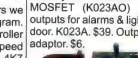

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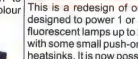
This is a redesign of our popular CFL kit and is designed to power 1 or a combination of compact fluorescent lamps up to 20W 50W or more with some small push-on heatsinks. It is now possible to buy some CFLs for less than $5ea from supermarkets and discount stores making this kit great for cheap alternative lighting for sheds & weekenders without mains power .K111B. $22



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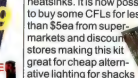

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(SC2) ELECTRIC BIKE:

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Pt.2: By JOHN CLARKE

Control your power costs with the:

ENERGY METER

Last month, we looked at the main features of the Energy Meter and described the circuit. This month, we present the full construction details and give the calibration procedure.

BUILDING THE ENERGY METER is quite straightforward but make sure that you refer to our warning panel. This is not a project for the inexperienced!

As shown in the photos, all the parts are mounted on two PC boards: (1) a main PC board coded 04107041 (138 x 116mm); and (2) a display PC board coded 04107042 (132 x 71mm) for the LCD module and switches.

Note that the display board was designed to accept three different LCD modules – from Altronics, Dick Smith Electronics and Jaycar. The straight-line 14-pin connection caters for the Altronics and DSE LCD modules, while the dual 7-way connection is for the Jaycar module.

Altronics, Dick Smith Electronics and Jaycar will all have kits for this project, so obtaining a kit will be easy. Note, however, that Dick Smith Electronics will be supplying a different case to the one used for our prototype. They've also altered the PC board layouts slightly, to get everything to fit inside their case. Their kit department built a fully-working prototype to confirm the design (see photo) and full instructions will be supplied with the kit.

Begin by checking the PC boards for the correct hole sizes. The LCD module and transformer require 3mm mounting holes, while the switches require 6.5mm holes. In addition, 2mm holes are required for the mains wire connections.

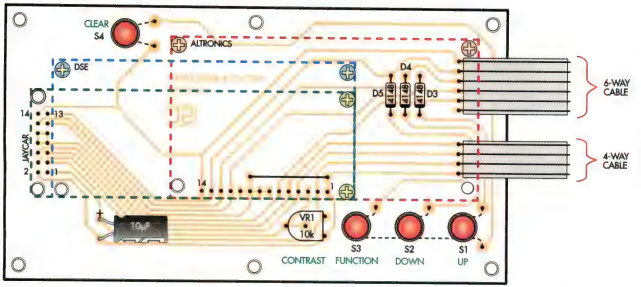


Fig.8: follow this layout to install the parts on the display PC board. The Altronics LCD module goes in the red position, the DSE module in the blue position and the Jaycar module in the green position.

Check also that there are no breaks in the copper tracks or shorts between any of the tracks or pads. Note, however, that one of the tracks on the main board has no connection at one end (ie, near the 10Ω resistor, to the right of the transformer). This is correct – this track simply functions as an earth guard, so don't join it to anything.

Display board assembly

Fig.8 shows the component layout on the display board. Install the wire link first, followed by trimpot VR1 and diodes D3-D5 (make sure the diodes are all oriented correctly)

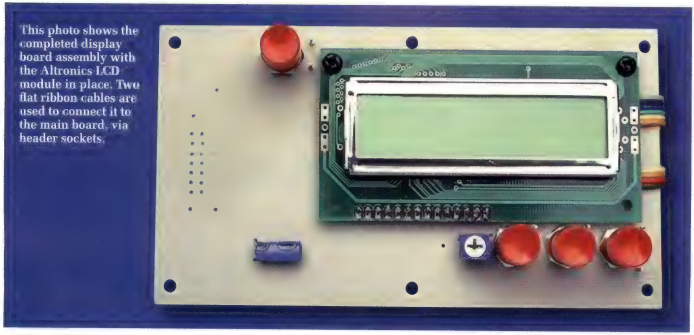
That done, install the 10µF capacitor, again taking care with polarity. It must be mounted with its leads bent at right angles, so that capacitor lies on its side against the board. This is necessary to provide clearance when the assembly is later secured to the lid.

If you are using the Altronics LCD module, the 6-way and 4-way rainbow cables need to be soldered into position now, since the LCD module covers the wiring points. Both cables should be about 120mm long. Similarly, you should also fit the six PC stakes adjacent to the switch positions – ie, two adjacent to S1, one each next to S2 & S3, and two adjacent to S4.

Now for the LCD module. Both the Altronics and DSE modules are connected to the PC board using a single in line 14-pin header, while the Jaycar module uses the dual 7-pin header instead.

Before mounting the module, fit two M3 x 9mm Nylon screws and nuts to the two corner positions opposing the header – see Fig.8. Do the nuts all the way up, then push the module down onto the PC board and secure it using two more Nylon nuts. Finally, make sure that the header is pushed flush against the PC board before soldering all the header pins.

The display board assembly can now be completed by installing the four pushbutton switches. The switch terminals are wired together and soldered to the PC stakes using



This photo shows the completed display board assembly with the Altronics LCD module in place. Two flat ribbon cables are used to connect it to the main board, via header sockets.

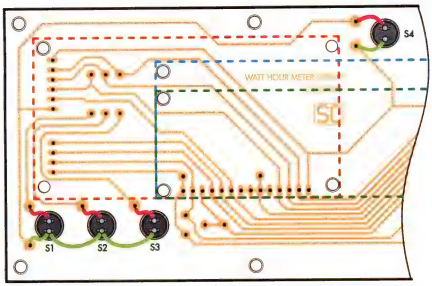


Fig.9: the switch terminals are wired together and soldered to adjacent PC stakes on the display board using 0.7mm tinned copper wire.

0.7mm tinned copper wire as shown on Fig.9.

Main board assembly

Fig.10 shows how the parts are installed on the main PC board. Begin by installing the links and the resistors but don't install the 0.01Ω 3W resistor (R1) or link R2 at this stage. You can use the colour code table (Table 1) as a guide to selecting each resistor but it's also a good idea to check the values using a digital multimeter, as some colours can be hard to read.

Next, install the diodes and bridge rectifier BR1, taking care to orient them as shown. That done, IC1 can be soldered directly to the PC board and a socket installed for microcontroller IC2. Don't plug the IC in yet – that step comes later, after a few initial checks.

The capacitors and crystals can be mounted now. Make sure that the 100µF and 1000µF 25V electrolytic capacitors are placed in the correct positions and check that all electrolytics are oriented correctly. Once they're in, install transistor Q1 with its metal tab facing towards the battery. Similarly, install regulator REG1 as shown.

The next step is to install PC stakes at all those points marked with a green asterisk (*). There are eight PC stakes in all. Follow these with the MOV and the 4-way and 6-way pin headers (the plastic guide tabs on the headers go towards the centre of the board).

Resistor R2 is next on the agenda. It is made using 0.2mm enamelled copper wire. Note that you must remove the enamel insulation from the wire where it is soldered to the PC board, so that the solder flows onto the bare copper. This can be done by heating the wire with a soldering iron so that the insulation melts, before applying the solder.

Resistor R1 (0.01Ω) can now be installed and soldered in place. Finally, complete the PC board by installing the 3-pin header (ie, to take link LK1 or LK2).

Battery back-up

The back-up battery is required only if the Energy Meter is to be used for long term measurements, where the elapsed time and kWh tally must be kept in memory if there is a blackout. **Most people will elect to leave the battery out, since they don't need this facility.**

If you do intend to use the battery, solder the battery clip lead to the PC stakes. A hole is also provided on the PC board for the battery holder and this is secured using an M3 x 6mm screw, nut and shakeproof washer. A dab of silicone sealant can be used to ensure that the nut cannot come loose.

Resistor R3 (680Ω, 0.5W) is installed on the PC board only if you intend using a rechargeable battery. Also, don't install the battery clip if you elect not to use battery back-up, as it could short out other components.

Although the battery holder provides a firm grip on the battery, it's possible that the battery could come loose if the case is subject to rough treatment or vibration. To prevent this, two M3 x 15mm tapped Nylon spacers are installed on the PC board at either end of the battery, to prevent horizontal movement.

Alternatively, these two Nylon spacers can be attached to the side of the case instead and at least one kit supplier has opted for this method.

A third Nylon spacer is later fastened to the side of the case above the battery to prevent vertical movement, thus effectively trapping the battery in its holder (see photos).

Note that all spacers should be at-

Table 2: Capacitor Codes

Value	µF Code	EIA Code	IEC Code
100nF	0.1µF	104	100n
33nF	0.033µF	333	33n
1nF	0.001µF	102	1n0
33pF	–	33	33p

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	2	2.2MΩ	red red green brown	red red black yellow brown
❑	1	10kΩ	brown black orange brown	brown black black red brown
❑	5	1kΩ	brown black red brown	brown black black brown brown
❑	1	680Ω	blue grey brown brown	blue grey black black brown
❑	1	68Ω	blue grey black brown	blue grey black gold brown
❑	1	10Ω	brown black black brown	brown black black gold brown

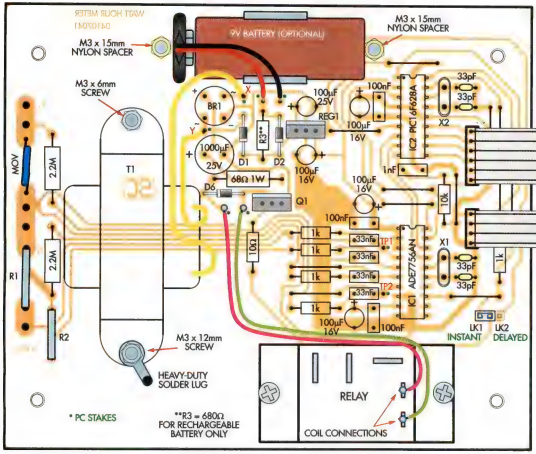


Fig.10: here's how to install the parts on the main PC board. Resistor R3 is installed only if a rechargeable back-up battery is used. Do not install the battery clip lead if you are not using a back-up battery, as it may short other components.

tached using M3 x 6mm Nylon screws. Use a countersunk Nylon screw to secure the spacer that's attached to the side of the case.

Attaching the header sockets

The next step is to attach the ends of the rainbow cable leading from the display PC board to the 4-way and 6-way header sockets using the supplied metal crimp connectors. These are crimped to the stripped wire ends and secured in place with the insulation clamp using small pliers. The connectors are then slid into the pin header socket shells (but make sure you get the headers the right way around).

That done, it's a good idea to go back over the two boards and check that all parts are correctly oriented and are in the correct locations.

Initial tests

Now for some initial tests of the PC board assemblies. In the interests of safety, these tests are carried out using a low-voltage DC or AC power supply (eg, from a plugpack). The step-by-step procedure is as follows:

(1). Connect a 12V DC or 10-12V AC supply to the X and Y PC stakes adjacent to BR1. If you're using a DC supply, it can be connected either way around since the bridge rectifier takes care of the polarity.

(2). Measure the voltage between REG1's tab and its output pin – you should get a reading of 5V. If the voltage is less than 4.75V or more than 5.25V, switch off the power immediately and check for incorrect component placement and orientation.

(3). Assuming everything is OK, switch off, plug IC2 into its socket (make sure that it is oriented correctly) and adjust trimpot VR1 on the display board, so that the LCD module shows good contrast between the background and the displayed characters.

(4). Check that the switches work by pressing the Function switch – the display should now show the cost in "$" rather than the "kWh" value (ie, at the lower righthand side of the display).

(5). Hold the Function switch down until the display goes to the cost per kWh calibration mode. When it does, check that the initial 10.0c value can be increased with the Up switch and decreased with the Down switch.

WARNING!

This circuit is directly connected to the 240VAC mains. As such, all parts may operate at mains potential and contact with any part of the circuit could prove FATAL. This includes the back-up battery and all wiring to the display PC board.

To ensure safety, this circuit MUST NOT be operated unless it is fully enclosed in a plastic case. Do not apply power to this device with the lid of the case removed.

This is not a project for the inexperienced. Do not attempt to build it unless you are completely familiar with mains wiring practices and construction techniques.

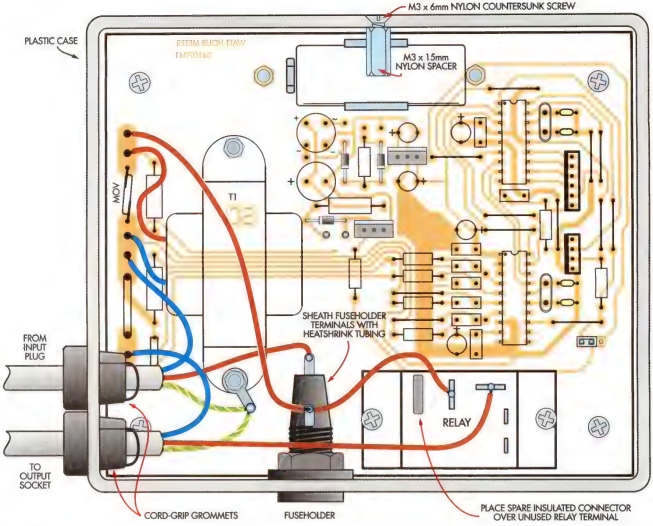


Fig.11: this diagram shows how to install the mains wiring. Note that all mains wiring connections to the PC board should be directly soldered (do not use PC stakes to terminate these connections).

(6). Press the Clear switch and hold it down for five seconds. The display should go back to the kWh reading.

Assuming it all works, you can disconnect the low-voltage power supply and move on to the next stage in the construction – installing power transformer T1 and the mains wiring.

Transformer mounting

Transformer T1 and the relay can now be mounted on the PC board. The relay is secured using two M3 x 6mm screws and nuts, while the transformer is fastened using an M3 x 6mm screw, nut and star washer on one side and an M3 x 12mm screw, nut and star washer on the other. The latter mounting screw is also used to secure the earth solder lug, by fitting an additional star washer and lock nut – see Fig.12.

After mounting the transformer, connect its 12.6V secondary leads to the X and Y PC stakes on the PC board. Similarly, connect its brown and blue primary wires to the Active and Neutral positions on either side of the MOV – see Fig.11.

Mains wiring

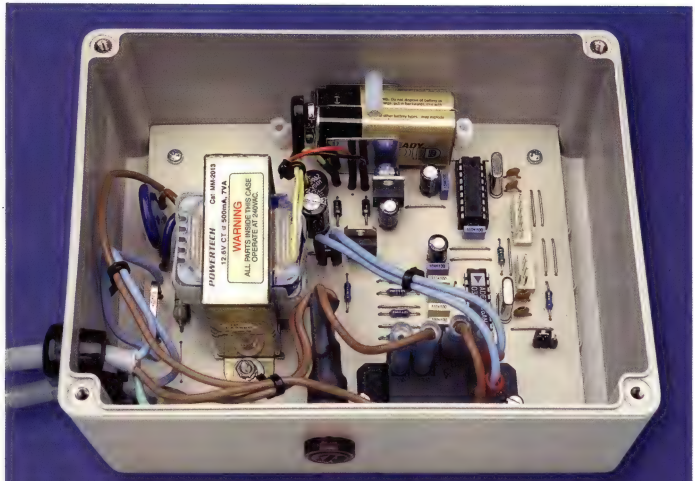
To ensure safety, be sure to use a plastic case to house the Energy Meter. There must be no metal screws going into this case. *DO NOT* use a metal case for this unit.

All kits will be supplied with a 2-metre extension lead, so you don't have to wire up the mains plug and socket. All you have to do is cut a 750mm-long section from each end of this lead, for the mains input and output cables. The remaining 500mm middle section is then used to complete the mains wiring after the input and output cables have been installed.

Begin the mains wiring by stripping back about 150mm of the outer sheath from each cable, then feed the two cables through the entry holes in the case (output cable at top). Solder their Neutral leads directly to the PC board, as shown in Fig.11 (do not use PC stakes here). Shorten each lead as necessary before soldering it to the PC board but don't make them too short – you don't want any strain on the leads once everything is in the case.

Once that's done, you can mount the safety fuseholder (be sure to use the correct type) and run the wiring to it. **Note that the lead from the mains input cord goes to the end terminal of the fuseholder**, while two other leads connect the middle terminal to the PC board and one of the relay terminals.

To ensure safety, the fuseholder should be sheathed in heatshrink tubing (see photo). This involves slipping a 35mm length of heatshrink tubing over the three leads before soldering them to the fuseholder terminals. That done, the heatshrink tubing is slid into position over the fuseholder body and shrunk down with a hot-air gun.



Use cable ties to bind the mains wiring as shown here, to prevent the wires from coming adrift. The fuseholder terminals are sheathed in heatshrink tubing and an insulated crimp connector is placed over the unused relay terminal to provide an extra margin of safety. Note, however, that all the circuitry operates at mains potential.

All connections to the relay are made by terminating the leads in insulated spade crimp connectors. Be sure to use a ratchet-driven crimping tool for this job, to ensure a professional result. Don't use a cheap crimp tool as supplied with automotive terminal sets – they aren't good enough for crimping mains connections.

Note also that for safety reasons, it is wise to place a spare insulated connector over the unused NC terminal of the relay – see Fig.11. Having said that, all parts and wiring in this unit could be at 240VAC (depending on the house wiring) but there's no harm in minimising the risk of contact.

Mains earth wiring

Now for the mains earth wiring – see Fig.12. First, slip a 25mm length of 6mm-diameter heatshrink tubing over the two earth leads, then twist the bared wire ends together and feed them through the hole in the solder lug. If the wires won't fit, it's simply a matter of slightly enlarging the hole by running an oversize drill bit through it

That done, the leads should be soldered to the lug and the heatshrink tubing pushed down over the connection and shrunk down to protect the joint and provide strain relief.

Finally, the solder lug can be attached to the transformer mounting screw using another nut and shakeproof washer. This arrangement not only anchors the solder lug but also provides earthing for the transformer case.

Be sure to follow the earthing arrangement exactly, as it's important for safety. In particular, note that the earth wires must be soldered. DO NOT rely on a crimp connection.

You can now complete the wiring

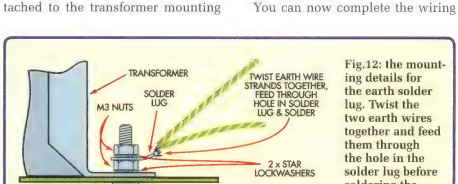


Fig.12: the mounting details for the earth solder lug. Twist the two earth wires together and feed them through the hole in the solder lug before soldering the connection.

This view shows the completed prototype (with the display board unplugged). The back-up battery is optional and won't be needed in most cases. Note the three Nylon spacers that are used to trap the battery inside its holder.

by running the leads between the relay coil connection terminals and the PC board. These leads are crimped to 2.8mm spade connectors at the relay end and soldered to PC stakes at the other end. It's a good idea to cover the latter connections with 2.8mm heatshrink tubing, to prevent the wires breaking at the PC stakes.

Final assembly

Now that the wiring has been completed, the PC board can be secured inside the box using the four supplied self-tapping screws (one at each corner). These screws go into integral mounting pillars within the box. That done, the mains cords should be clamped securely in position using the supplied cord clamp grommets.

Note that these cord clamp grommets must grip the mains cords tightly – you must not be able to pull the cords out, even if you place considerable strain on them. Check this – it's important to ensure your safety.

With the cords now secured, use cable ties to lace the mains wiring together, as shown in the photo. This not only keeps the wiring looking neat and tidy but also prevents the leads from breaking since they can no longer "move about".

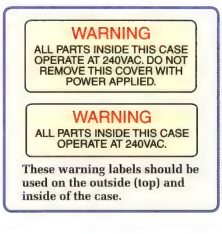
Next, secure the display board to the lid of the case as shown in Fig.13. This is mounted on six M3 x 12mm Nylon spacers, which in turn are secured to the lid using M3 x 6mm countersunk Nylon screws.

Important: you must use Nylon screws where shown on all diagrams, to ensure that all mains voltages remain within the case. There must be NO metal screws protruding through the Energy Meter's case.

The display board headers can now be plugged into their corresponding header pins on the main board. That done, the optional back-up battery can be installed by fitting the battery clip, then pushing the battery down into its holder, so that it sits between the two board-mounted Nylon spacers at either end. The remaining M3 x 15mm Nylon spacer should then be installed immediately above the battery (see Figs.10 & 11) and secured using an M3 x 6mm countersunk Nylon screw.

There's just one more thing you have to do before attaching the lid – place a shorting link onto either LK1 or LK2. Select the LK1 position if you want the relay to immediately switch on when power is restored after a brownout or blackout. Alternatively, choose the LK2 position so that the relay only switches on after an 18-minute delay when power is restored.

Finally, attach the lid to the case, making sure that there are no components are shorted as the lid closes. The supplied metal screws can be used to secure the lid to the case, since they do not go inside the box.

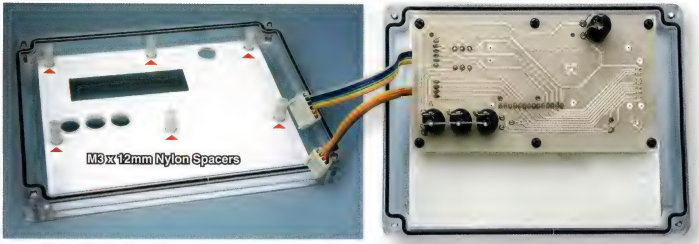


These warning labels should be used on the outside (top) and inside of the case.

Calibration

The Energy Meter is now ready for calibration so that it will display the correct wattage, kWh and energy costs. Calibration will also allow the brownout operation to function correctly.

As detailed in the accompanying panel, the various calibration modes are accessed by holding down the Function switch. Here's the procedure for each mode:



The six 12mm-long M3 Nylon spacers are secured to the lid of the case using M3 x 6mm Nylon countersink-head screws. The display is then secured to these spacers using cheesehead M3 x 6mm screws.

(1). COST: for the energy cost adjustment, the display will show CENTS/kWh on the top line and the cost (eg, 10.1 Cents) on the lower line. The correct rate can be obtained from your electricity bill but note that some electricity suppliers have different rates, depending on the amount of electricity used.

This means that you will need to decide which rate applies to the appliances being measured.

(2). ZERO OFFSET: the OFFSET adjustment is made without a load connected. Press the Up or Down switch so that the wattage value stays at 0.00W (if a negative value is showing, the calibration value should be increased so it shows 0.00).

Generally, the value should not need to be altered much from the default setting. When changing values, it is important to wait for at least 11 seconds so that the wattage value will update to its current reading with the new offset value.

(3). POWER ADJUSTMENT: The POWER adjustment sets the calibration of the wattage reading. This is done by connecting a high-current resistive load such as a two-bar radiator which can draw at least 5A (ie, a radiator with a rating of 1000W, or 1kW).

Alternatively, you could use a 2.4kW radiator which draws up to 10A instead. Here's the procedure:

(a). First, you need to measure the resistance of the radiator when the elements are hot. To do this, set your multimeter to measure ohms and plug the radiator into a mains socket. Allow the elements to heat up to fully red for a few minutes, then pull out the mains plug and quickly measure the resistance of the elements by connecting the multimeter probes between the active and neutral pins on the plug.

Note that this resistance will begin to drop as the elements cool. Make a note of the highest reading and repeat the procedure by heating the radiator up again.

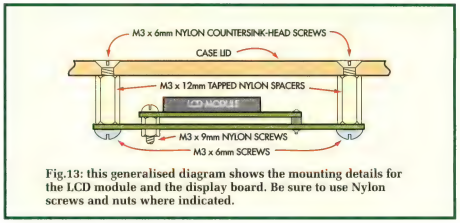
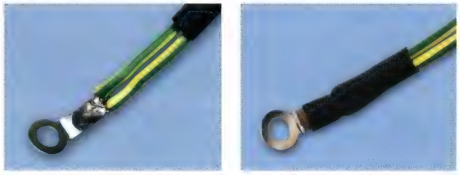


Fig.13: this generalised diagram shows the mounting details for the LCD module and the display board. Be sure to use Nylon screws and nuts where indicated.

(b). Now measure the resistance the meter shows when the two probes are connected together. This may be around 0.1Ω and this value should be subtracted from the radiator element reading to obtain the true radiator resistance value.

(c). Carefully measure the mains voltage using suitable mains-rated multimeter probes, with the meter



The two mains Earth leads are twisted together, fed through the hole in the soldering lug and then soldered. A piece of heatshrink tubing is then slid down and shrunk over the connection to keep the leads together and provide strain relief. Use a small drill to enlarge the hole in the solder lug to accept the twisted Earth wires if necessary.

Calibration Selections

(1) The first calibration selection is the **ENERGY COST ADJUSTMENT**. The display will show "CENTS/kWh" on the top line and the cost (eg, 10.0 cents) on the lower line. The cost/kWh can then be adjusted from 0 cents to 25.5 cents in 0.1 cent steps by using the Up and Down switches to select the required value.

(2) The next calibration selection is the **OFFSET**. This is used to zero the wattage reading to 0.00W when no load is connected.

Basically, the Offset adjustment removes the effect of crosstalk between the current and voltage signals, which could otherwise cause a wattage reading to be displayed with no load connected. Setting this adjustment also prevents the kWh reading from increasing when the load is connected but there is no load current.

During calibration, the word "OFFSET" is shown on the lefthand side of the display, while the current wattage value is shown to the right. Below this is the offset calibration value, which is shown between < and > brackets. The initial value is 7 but this can be adjusted from -2048 to +2048 in steps of 1 using the Up and Down switches. Each step represents an adjustment of about 0.12% in the wattage reading.

(3) The **POWER** adjustment is next in the sequence and is used to calibrate the kWh value. The power calibration values are adjustable from -2048 to +2048 in steps of 1, with each step representing a change of 0.0244%. This gives an overall adjustment range of ±50%.

(4) Next comes the **PHASE SHIFT** adjustment facility. This alters the phase difference between the measured voltage and measured current.

With a resistive load, the phase difference between the voltage and the current should be 0 – ie, they are in phase. However, the mains voltage monitoring and the current detection circuitry used in the Energy Meter can introduce small phase changes that need to be compensated for.

These phase differences can be trimmed out in 62 4.47µs steps, ranging from -138.6µs to +138.6µs. This is equivalent to 0.08° per step at 50Hz, with a 2.49° maximum leading or lagging adjustment.

(5) The next pressing of the Function switch displays the Brownout **SAG LEVEL**. If the mains voltage falls below this preset value, then a brownout condition is flagged on the lower lefthand side of the display (ie, the display shows "SAG"). Typically, the brownout voltage can be adjusted from 290V all the way down to 0V in 57 steps of about 5.1V each.

(6) The **SAG LEVEL CAL** is the next mode in the sequence. This calibrates the voltage reading shown for the brownout (SAG) threshold level and the hysteresis, so that the unit trips correctly at the set voltage. This adjustment is available in 180 steps using the Up and Down switches, with each step changing the voltage reading by about 5V.

(7) Next comes the **SAG HYSTERESIS** (Brownout hysteresis) adjustment. This sets the voltage above the SAG LEVEL to which the mains must rise before the brownout indication (SAG) switches off. Again, this voltage is typically adjustable in 5.1V steps from 0-290V.

This hysteresis is included to prevent the brownout detection from repeatedly cycling on and off at the trip point.

(8) The final mode is the **SAG HALF CYCLES**. This sets the number of mains half-cycles over which the brownout voltage must stay below the SAG Level before a brownout is detected.

This factor is adjustable from 1-255 half-cycles in steps of one half-cycle. The default value is 100 (equivalent to a period of 1s for 50Hz mains), which means that the mains voltage must stay below the SAG Level for 100 half-cycles before a brownout is detected.

If the brownout facility is not required, the SAG LEVEL can be set to 0V (or to a very low voltage). This will effectively disable brownout detection and power will always be applied to the appliance.

Once all the calibration modes have been cycled through, pressing the Function switch again returns the display to its "normal" mode – ie, so that it shows the measured values.

set to measure 250VAC.

(d). Using a calculator, square the mains voltage reading (eg, 240V x 240V = 57,600) and divide the result by the true resistance of the radiator (eg, 57,600/50.0 =1152W). The result is the wattage drawn by the radiator.

(e). Plug the radiator into the Energy Meter's socket and adjust the POWER calibration value until the display shows the calculated wattage value. Pressing the Up switch will give a higher wattage reading on the display, while the Down switch will give a lower wattage reading. Be sure to wait 11 seconds after each adjustment, so that the display has time to update.

The actual value may change on each wattage update but it should average out to the calculated value. The calibration should be accurate to better than 0.5%, providing the mains voltage has not altered and that the multimeter is accurate.

Note that the kWh calibration is also set by calibrating the wattage reading and is effectively locked to this calibration. Typically, the wattage measured each second is divided by 3600 (the number of seconds in one hour). This divided value is then added every second to the existing kWh value.

Note also that to convert from watthours to kWh, the value is divided by 1000. In the Energy Meter, we are obtaining the wattage over a 10.986328-second period and so we do not divide by 3600 and then by 1000. Instead we divide by 32,768 and then by 10. The result is the same.

(4). PHASE SHIFT: this adjustment is not required for most purposes. This is because we have used resistive current and voltage sensing and this will not alter the phase by any significant amount.

However, phase compensation will be required if a different current sensor is used that introduces a phase error. For example if a current transformer is used in place of the 0.01Ω resistor (R1) and it introduces a phase lag of 0.2°, then a phase correction of 0.2° will be needed.

The phase correction is made in the amplifier 2 signal chain. This means that a phase lag in channel 1 will require that a similar phase lag be introduced into the second channel. Note that this phase lag (or delay) in channel 2 is a positive value.

Alternatively, if the current transducer introduces a phase lead, then the delay in channel 2 will need to be a negative value.

The conversion from phase shift in degrees to phase shift in microseconds is made using the equation: *shift in degrees = 360 x phase value in seconds x 50Hz*. Alternatively, *phase shift in seconds = shift in degrees/(360 x 50)*.

For example, a 0.2° phase shift is equivalent to an 11.1µs shift. In this case, we use the closest setting which is 13.4µs (the phase settings are in 4.47µs steps).

(5). BROWNOUT: four parameters must be set here: SAG LEVEL, SAG LEVEL CALibration, SAG HYSTERESIS and SAG CYCLES.

The Dick Smith Electronics version is built into a plastic instrument case and features slightly revised PC board layouts to suit the new layout. Note: prototype unit pictured here.

The SAG LEVEL and SAG HYSTERESIS should both initially be at 0V, while SAG CYCLES should be set to 100 cycles. If these are not already set to these values, select the required mode using the Function switch and adjust the value using the Up and Down switches.

If brownout detection isn't required, simply set the SAG LEVEL to 0V and skip the following procedure by pressing the Function switch until the display shows the hours, wattage and energy consumption.

Parts List Addenda

The following items should be added to the parts list:

2 M3 x 9mm Nylon screws
4 M3 Nylon nuts
1 M3 x 6mm screw
1 M3 x 12mm screw
1 M3 metal nut
3 M3 star washers
1 50mm length of 6mm diameter heatshrink tubing

Note 1: the six M3 Nylon countersunk screws specified for attaching the display board spacers to the lid should all be 6mm long (not 10mm).

Note 2: the 6 M3 x 12mm tapped spacers for mounting the display board should be made from Nylon.

Note: 3: the earth lug must be a solder lug. Delete the crimp lug option.

These items are also required if the back-up battery is fitted:

3 M3 x 15mm Nylon spacers
1 M3 x 6mm Nylon countersunk screw
2 M3 x 6mm Nylon screws

For brownout calibration, just follow this step-by-step procedure:

(a). Select the SAG LEVEL mode, then carefully measure the mains voltage using a multimeter with mains-rated probes (and set to read 250V AC).

(b). Set the SAG LEVEL voltage using the Up switch until the SAG indicator shows. Check that this is the correct SAG threshold by stepping down in value to check if the SAG indication goes off. Note that these changes must be done slowly since there will be a 1-second lag for SAG detection.

Note also that the voltage reading will probably not be the same as the measured mains voltage. This can be corrected by accessing the SAG LEVEL CAL mode and adjusting the reading shown on the lower line to be as close as possible to the measured mains voltage.

(c). Reduce the SAG LEVEL to a suitable value for brownout detection. Setting a low voltage will reduce the likelihood of a brownout indication and if set at below 50V, will completely prevent brownout detection. Conversely, setting the SAG LEVEL voltage too high will cause nuisance brownout detection.

A setting of between 200V and 180V should be suitable.

(d). Adjust the SAG HYSTERESIS (brownout hysteresis). This sets the voltage that the mains must rise above the SAG LEVEL before the brownout indication switches off. In other words, the mains voltage must rise by the SAG Hysteresis value above the SAG Level in order to reapply power to the appliance.

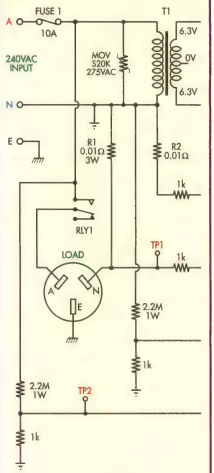
Generally, a setting of about 5-15V would be suitable here but make sure that when you add this hysteresis voltage to the SAG level, the result is less than the normal mains voltage. If not, the brownout detection (and indication) will remain in force after the power returns to normal (and the appliance will remain off).

(e). Finally, set the SAG HALF CYCLES. You should use a value greater than 50 here, to ensure that any momentary drops in the supply voltage are not detected as a brownout.

A value of 100 should be suitable. This means that the brownout must last for at least one second before the relay switches off to disconnect power.

That's it – your new Energy Meter is now ready for use. **SC**

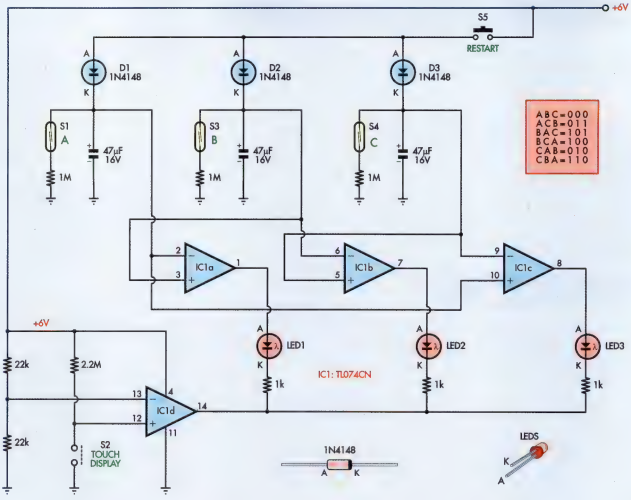
Circuit Correction



There are a couple of errors in the circuit published last month. First, the 2.2MΩ resistor shown connected to the Active terminal of the load socket should in fact connect to the Active input via Fuse 1. Second, the relay connections were incorrectly shown. The corrected circuitry is shown above. Note: the wiring diagrams (Figs.10 & 11) are correct.

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Electronic conjuring trick

This circuit was developed in response to a request from a Scottish conjurer. He wished to place four small, coloured balls on stage, each a different colour, and then invite members of the audience to come up and put one in their pockets.

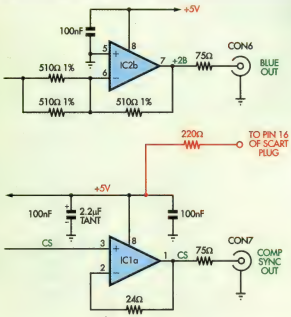
He wanted to be able to tell who had which colour without actually seeing the balls they had taken. This he could do if he knew the sequence in which the balls had been taken.

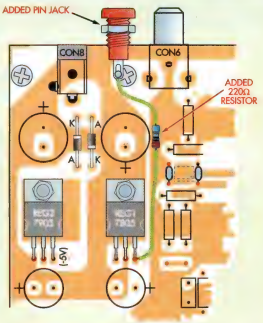
The trick is implemented here with three balls instead of four, since this is simpler by an order of magnitude.

At first glance, three sets of three LEDs could be used to give an indication of the order in which each ball was taken. However, such a circuit would be complex, with a readout comprising nine LEDs in all. With a combined analog and digital approach, the number of LEDs can be reduced to just three.

There are six possible sequences in which three balls could be taken. Supposing that we label the balls A, B and C. Ball A could be taken before ball B and vice versa. Ball B could be taken before ball C and vice versa. And ball A could be taken before ball C and vice versa. If each of these orders of priority can be recorded with a single LED (the LED being illuminated if the second ball is taken after the first), the trick is complete.

The trick commences with the charging of the three 47µF capacitors through pushbutton switch S5. Initially, each of the reed switches (S1, S3 & S4) are closed by a magnet mounted inside each of the coloured balls. This means that as soon as S5 is released, the capacitors begin to discharge. With the component values shown, discharging takes almost





Adding an "RGB Flag" output to the Component Video/RGB Converter

Some large-screen TV sets which are fitted with a SCART-type AV input connector need a positive 'flag' voltage fed to pin 16 of the SCART connector, to indicate when the input signals are in RGB component format. If this voltage is not present, the TV will not recognise the RGB signals and process them correctly.

The Component Video to RGB Converter design we published in the May 2004 issue of SILICON CHIP didn't provide a DC flag voltage output for this purpose but it's easy to add one if your TV set needs it. All you need to do is make an extra hole in the Converter's rear panel, between CON6 and CON8, and fit a small 'pin jack' socket. Then a 220Ω resistor is connected from the pin jack's solder lug to the +5V output of the 7805 regulator REG1, as shown in the diagrams.

If your main RGB cable taking the video outputs of the Converter to your TV set doesn't have a wire connected to pin 16 of the SCART connector, you'll need to add one using a length of insulated hookup wire. The Converter end of this wire (or the existing wire in the cable connected to pin 16) is then fitted with a pin jack plug, to mate with the added socket.

SILICON CHIP.

a minute; therefore all three balls must be taken within this time frame (the capacitor values can be changed to suit). A JFET input op amp with high input impedance was chosen for IC1 so that discharging through the inputs of the IC is negligible.

When a ball is removed, the associated reed switch opens and the discharging of the capacitor in that circuit is "frozen", performing a simple sample-and-hold function. IC1a, IC1b and IC1c compare the remaining charge on each capacitor, with the resultant sequence appearing on the three LEDs.

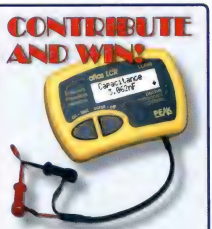
The conjurer may either remember which sequence of illuminated LEDs corresponds with each sequence of coloured balls or he or she could work out the logic directly each time, perhaps "thinking out loud" about the three orders of priority displayed by the LEDs.

The conjurer might not wish to risk having the LED readout permanently "on", therefore the LEDs are enabled only when two metal points (perhaps pinheads) are touched with a moistened finger. Comparator IC1d provides this function, with its output normally "high" until the noninverting input is pulled towards ground by finger contact on S2.

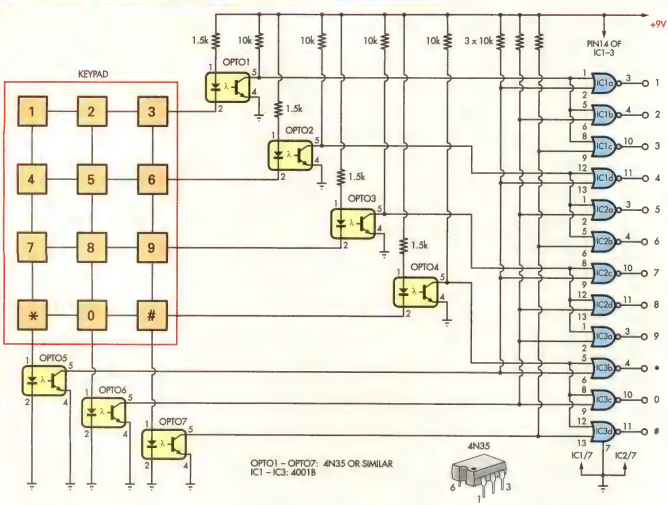
Since the trick relies on consistent discharging of the three capacitors, these capacitors, together with the associated diodes, resistors and reed switches, should all be matched.

If the trick is performed with only a moderate level of expertise, it should baffle and astound.

Thomas Scarborough, South Africa. ($40)



As you can see, we pay good money for each of the "Circuit Notebook" contributions published in SILICON CHIP. But now there's an even better reason to send in your circuit idea: each month, the best contribution published will win a superb Peak Atlas LCR Meter valued at $195.00. So don't keep that brilliant circuit secret any more: send it to SILICON CHIP and you could be a winner!



Keypad decimal encoder

This simple design can be used as part of a combination lock or other controller circuit, where an individual output for each button press is required. It uses a conventional keypad with 12 keys and 7 pins (eg, Jaycar Cat. SP-0770).

Pressing a button connects the associated row and column lines together. Each row and column output is connected in series with the LED of a 4N35 optocoupler. The optocoupler outputs drive a matrix of 4001 NOR gates, which in turn encode the button press to provide a logic high level on just one of the 12 outputs.

For example, pressing button "5" connects the LEDs in OPTO2 & OPTO6 in series. This completes a circuit from the +9V rail, through a 1.5kΩ current-limiting resistor and the two LEDs to ground. Both optocoupler transistors conduct, pulling the inputs of IC2a low.

The result is a logic high at the "5" output, with all other outputs remaining low.

Peter Howarth,
Gunnedah, NSW. ($40)

PICAXE-controlled solar fountain

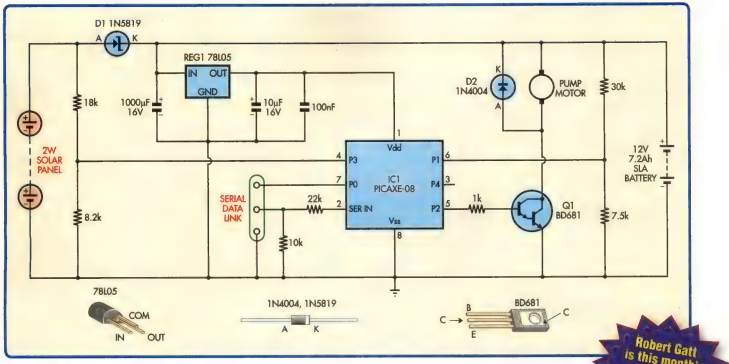
Add a solar-powered fountain to your fish pond or garden water feature with this unique PICAXE design. The prototype was constructed with a low-cost 12V DC camping shower pump (available from Jaycar), a 2W solar panel and a 12V 7.2Ah SLA battery for energy storage.

A PICAXE-08 micro controls the fountain pump, switching it on for 30-second bursts whenever sufficient battery power is available. Pulse-width modulation (PWM) of the pump motor is used to reduce average current, providing a more appealing water flow as well as longer running time.

The voltage from the solar panel is divided down by 18kΩ and 8.2kΩ resistors before it is applied to a PICAXE digital input on P3 (pin 4). When the panel output is higher than about 8V, the input will read high, whereas lower voltages will read low. The program uses this input to differentiate night from day, eliminating the need for an LDR sensor.

Two resistors also divide the battery voltage down before it is applied to the PICAXE analog input on pin 1 (leg 6). The program periodically reads this input and using simple logic, chooses one of several strategies.

If the battery voltage is less than about 11.4V, the pump is not driven and the program "sleeps" for 10 minutes. Between about 11.4V and 14.5V,



Robert Gatt is this month's winner of the Peak Atlas LCR Meter

the pump is driven for 30 seconds followed by either 3, 5 or 10-minute rest periods.

Above 14.5V, the pump is again driven for 30 seconds but the previous rest period is halved. If the voltage is still above 14.5V the next time around, the rest period is halved again, and so on. This prevents the battery from being over charged, as the power used by the pump will always be higher than the power produced by the panel.

PWM output from the PIXACE on P2 (pin 5) drives the pump via a BD681 transistor (Q1). The programmed speed is sufficient to pump water through the fountain at a pleasing rate, with an approximate current consumption of 200mA/h.

As you can see, the pump will turn on more often the sunnier it is. I have run this system for over a week with the battery voltage sitting just below 13.5V and the fountain coming on every 15-30 seconds during the sunniest part of the day.

Robert Gatt,
Port Fairy, Vic.

```
'-----------------------------------------------------
' Solar Fountain Pump Controller
'-----------------------------------------------------
'pins:
'2 = output to motor driver transistor
'1 = input to read battery voltage
'3 = input to check for daylight

symbol volts_11          = b0
symbol volts_12          = b1
symbol volts_13          = b2
symbol volts_14          = b3
symbol sleep_time        = b4
symbol read_volts        = b5
symbol motor_count       = b6
symbol counter           = b7
symbol short_sleep       = b8
symbol medium_sleep      = b9
symbol long_sleep        = b10
symbol day_status        = b11

volts_11 = 117           'approx. 11.4V
volts_12 = 128           ' 12.5V
volts_13 = 138           ' 13.5V
volts_14 = 149           ' 14.5V

short_sleep = 80         'approx. 3 minutes
medium_sleep = 130       '5 minutes
long_sleep = 255         '10 minutes

motor_count = 30

  wait 3
  sleep_time = short_sleep

main:
  debug b0               'use debug to check voltage

  if pin3 = 1 then goto day

night:
  day_status = 0   'useful for debugging
  goto sleeper
  goto main

day:
  day_status = 1   'useful for debugging

  readadc 1,read_volts

  if read_volts > volts_14 then goto v_high_volt
  if read_volts > volts_13 then goto high_volt
  if read_volts > volts_12 then goto medium_volt
  if read_volts > volts_11 then goto low_volt
  if read_volts <= volts_11 then goto sleeper

low_volt:
  sleep_time = long_sleep
  goto spin

medium_volt:
  sleep_time = medium_sleep
  goto spin

high_volt:
  sleep_time = short_sleep
  goto spin

v_high_volt:
  if sleep_time <3 then goto keep_same
  sleep_time = sleep_time/2
  goto spin

keep_same:
  sleep_time = 2
  goto spin

spin:
  pwm 2,200,125          'kick start motor

  for counter = 0 to motor_count
  pwm 2,100,125
  next counter

sleeper:
  sleep sleep_time
  goto main
```

You will need to load this program into your PICAXE-08. PICAXE chips and programming cables are readily available – see www.microzed.com.au

ALTRONICS

■ INTERNET
www.altronics.com.au

■ EXPRESS ORDER HOTLINE
1-300 797 007

REMINDER!

Our Sydney store is open 6 days a week and is now servicing all NSW mailorder & in-store customers! Located at 15 Short St. Auburn. DROP BY AND SEE US TODAY!

AUGUST FABULOUS FREEBIE!

Purchase products from the August specials to the value of $100 or more and you will receive a FREE weather resistant torch (valued at $7.95). Only while stocks last. AMAZINGLY HANDY! KEEP IT ON HAND FOR EMERGENCIES!

INSPECT-A-GADGET® JUNIOR IS HERE!

NO MORE EYE STRAIN!

NEW

A magnifying lamp for under $50? YOU BET! Let junior-gadget be your eyes! Identify those impossible to read miniature components, without straining your eyes. Great for stamp and coin collectors, model makers, seamstresses, jewellers etc. 300mm adjustable gooseneck

$49
A 0967
5 Diopter

Features an ultra-bright fluorescent tube for extra crisp, clear view!

SAVE A FORTUNE ON BATTERIES!

$39.95
A 0289

No longer will you have to buy regular batteries for your appliances & devices. This charger will charge up to 4 NiCad or NiMH batteries at once, ensuring they're kept in top condition by discharging each cell before charging. Suits for AAA, AA, C, D, 9V batteries. *No discharge function for 9V.*

SPECIAL DEAL!

Get $10 off the price of the A 0289 when you buy 2 packs of NiMH batteries! (below).

Why waste $$$ on throw away batteries?

When these high power, long lasting nickel metal hydride rechargeable batteries are good for up to 1000 recharges! ie: They will last you for DONKEYS YEARS!

UP TO A HUGE 2.3Ah CAPACITY!

Fantastic for digital cameras!

	AAA Size 900mAh*	AA Size 2300mAh*
	S 4742B	S 4746C
Single Pack	$9.95	$11.95
buy two or more packs & save		
Two+ Packs	$8.50	$10.50

Protect your family, possessions and home from criminals today!

NOW WITH DIALLER!

At last a quality and AFFORDABLE professional alarm system. Install it yourself and save a fortune! Why pay a fortune to a security company for monitoring, when this "dialler" alarm system will phone you (or 4 other numbers) when it is triggered. Supplied in 2 compact parts (lock box & keypad) and can be fully installed and programmed by **YOU** in just hours. It's just that easy. It's by far the easiest alarm system we've ever evaluated! This comprehensive system features: • 6 individual zones with single or multiple triggering • Master & user codes • Recordable dialler message • Entry/exit delay • Battery backup option • Easy keypad programming • Full system status display at keypad • Remote software monitoring option • 12 month warranty

$349
RRP $399
S 5264

Protect windows from intruders!

This tiny unit can detect glass breakages up to 8m away and uses both high and low frequency detection to avoid the false alarms that cheaper detectors are prone to. Powered by 12VDC with NC contacts to suit most alarms.

$40
RRP $49.95
S 5365A

Everything you need for your alarm system in one handy pack!

Save a fortune & buy all your accessories at once! This comprehensive package includes:

- Backup battery
- Power supply
- 2 x PIR detectors
- Warning stickers
- Door reed switches
- 50m security cable
- 30m flg. 8 cable
- Tamper switch
- Strobe light
- Siren
- Siren cover

$200
RRP $225
S 5262

Cable free gaming!

NEW

These wireless controllers for X-Box® and PS2® consoles give you the freedom of playing anywhere in your lounge room! You could even get up for a beer from the fridge and keep playing (10m range). They use a 4 channel radio frequency system ensuring reliable control & the flexibility of using up to 4 controllers at once.

$79 Save $70
X-Box
X 3001

$79 Save $70
PS2
X 3003

ALSO NOW AVAILABLE: Wired replacement controllers for X-Box (X 3002) and PS2 (X 3004). $19.95ea

Instant battery tester

The FASTEST way **to check battery life, ANYWHERE! ANYTIME! Make sure you've got your money's worth out of your batteries!** Tests: D,C,AA, AAA,9V & button cells.

HOT PRICE!

$4.95 ea
Q 3200

Video Door Phone

Check who's at the door before opening it!

$189
RRP $199
S 9410

A safe and easy way to monitor your front door ***day or night!*** When the call button is pushed by your visitor the base station will show vision of your visitor and allow them to speak with you directly. Coupled with a **S 5385** door strike ($47.20) you can even remotely unlatch your front door/gate to let visitors in. Black & White only.

SUPPLIED WITH CABLING & POWER SUPPLY: NOTHING MORE TO SPEND!

NEW

"WALKIE TALKIE" 40 ch. UHF Radio BARGAIN!

Stay in touch with your mates up to 5KM away - FOR FREE!

No licence required! Perfect handheld radio for recreation, building sites, 4WDs, hikers, campers etc. ***Features:*** • Backlit LCD • Channel scan • Call tone • Battery indicator • Dual channel monitor • Stopwatch • VOX • Repeater mode. Requires 4 x AAA batteries.

$40 ea or $90 pr
X 0500

HEAPS OF ACCESSORIES AVAILABLE!

STARTER PACK BONUS! ***Get everything you need to get started and SAVE! Buy a pair of X 0500 UHF radios, 8 x AAA rechargeable batteries AND a charger for $120! SAVE $32.69!*** (X 0500S)

High Power PA System

An excellent sound solution for clubs, mobile DJs, church groups, schools etc. Includes a 2 channel 200W Biema amplifier (A 4154), a pair of 10 inch high power 130W RMS Redback speakers (C 1000) and 2 x 10 metre leads (P 0685)! Fantastic for addressing large crowds at sports events, fetes, demonstrations, fairs, rallies etc. This powerful PA pack will produce clear and crisp sound reproduction for both music and speech.

SAVE OVER $200!
These will not last at this amazing price!

$899
RRP $1101
C 10005

Turn your TV into a video intercom!

NEW

This compact unit provides a quick inexpensive way to monitor your front door, or even your front yard! It simply connects up to your television (10m cable included) and provides live, clear colour video from the camera unit outside. The wall mount intercom unit lets you speak to people outside without opening the door. Power supply included

$149
S 9408

Check who is at the door before opening it simply by connecting this unit up to your television! A great inexpensive security solution!

DELUXE LCD REMOTE CONTROL:

REPLACE UP TO 8 REMOTE CONTROLS WITH ONE!

Coffee table covered in remotes again? Tired of juggling a handful of remotes just to watch a movie? With hundreds of pre-programmed codes or IR learning, the A 0988 can easily combine all the functions of your current remotes into one stylish unit. Lights up as soon as you touch it, even in the dark!

$179
RRP $199
A 0988

TURN AA's INTO C's & D's

These simple adaptors accept 1 AA battery and turn it into a C or D size! Packs of 4.

$4.95
AA-D
S 4609

$3.95
AA-C
S 4607

NOW! YOU CAN USE YOUR AA'S IN MOST BATTERY POWERED APPLIANCES!

NEW

TEST EQUIPMENT

19 Range Multimeter Bargain!

Perfect for the cash strapped student, enthusiast or handyman. With its built in transistor & diode tester it represents fantastic value for money.

NEW

$11.95 Q 1053A

Great meter for the budding enthusiast!!

Multifunction Automotive Meter

Great for mechanics, apprentices or car nuts! Serves not only as a standard multimeter, but also performs RPM, dwell angle, duty cycle, temperature and pulse width measurements. Supplied with inductive pick up.

NEW

$129 Q 1162

DIAGNOSE CAR PROBLEMS YOURSELF! You could easily save a fortune on tune ups & repairs!

True RMS AC/DC Clamp Meter

NEW

Quickly and accurately measures the AC or DC current flowing through an individual conductor, up to a MASSIVE 600A!

Engineered to survive the rigours of use in the field. A professional quality unit with advanced features such as true RMS AC measurement, resistance, temperature, capacitance, zero & hold functions - **All supplied with a handy carry case & test leads.**

$169 Q 0966

GREAT PRICE! AMAZING FEATURES!
Essential test equipment for technicians, instrument fitters & electrical tradespeople!

21 range Digital LCR Meter

This super accurate LCR meter is perfect for developing audio crossovers, switch-mode power supplies, resonant filters & RF circuits. Allows quick measurements of inductance, capacitance and resistance. • Diode test function • Jumbo LCD display for easy reading • Test leads, carry case and rubber holster included.

$99 Q 1154

Compact Autoranging DMM

This great autoranging multimeter allows handsfree operation when testing! Great for working in tight spaces or for those who just want added convenience. **Features:** • Manual override of autoranging • Data hold • Backlit display • AC/DC volts • Resistance • Continuity • AC/DC current • Transistor & diode checker

$20 RRP $26.95 Q 1130

INCLUDES A 1300°C TEMPERATURE PROBE FOR NO EXTRA COST!

Create your own PCBs and save a fortune!

Get first class results from one-off PCBs with this easy to use etchant tank. Ensures efficient, clean and safe etching. Add some consumables to your order:
H 0755 Single sided 300 x 300mm PC board $19.95
H 0756 Double sided 300 x 300mm PC board $21.50
H 0802 Ammonium persulphate etchant, 600g, $12.55

Includes aeration pump, heater and clips for suspending PCBs in the etchant.

NEW

$89 T 3200

2 IN 1 Soldering Station & Fume Extractor

Are you sick of soldering in a smoke filled workshop? Well why not whisk the fumes away with this professional quality ***ALL METAL*** *fume extractor & soldering iron combination. Built tough to ensure it will last you for many years to come!* • High 60W power output (250-430°C range) suits just about any job • 1.6mm tip • Iron stand & sponge included.

SAVE BIG $$$ ON BUYING SEPARATE UNITS!

$169 T 2444

240V Mains power from a 12V car battery

$85 RRP $99 **M 81025** 150W

$129 RRP $149 **M 81125** 250W

$299 RRP $349 **M 81325** 750W

Laptops, portable hi-fi's. | *Battery chargers, portable TVs.* | *Power tools, lighting, small pumps, drills, angle grinders.*

• **Mains power for your appliances anywhere, anytime.** • Powered from a 12V battery • Fantastic for mobile tradesmen, farmers, and camping. • Modified sinewave

Keep your gear powered up, even on the road! Great for cars, vans, boats, caravans etc.

FREE *6 WAY SURGE PROTECTION POWERBOARD WITH EACH INVERTER SOLD IN AUGUST! P 8141 valued at $15.*

Lead Acid Battery Charger

Automatic trickle charging unit keeps your SLA batteries in top nick! Suits 1.2Ah to 7.2Ah batteries.

$19 RRP $27.50 **M 8520**

Shielded 2 Core

Perfect for connecting audio wall plates around the house, or making your own custom audio cables. "Full 100m rolls only.

$40/100m RRP $50/100m **W 3020**

RACE IN FOR THE BULK SAVINGS!

"Under carpet" Flat Cable

NEW

Fits under your carpet to make cable runs neater and easier. Perfect for both home and car audio systems.

$70/100m **W 2980**

Great for discrete custom installs! BUY A 50M ROLL AND SAVE!

Whopper Cable

SAVE 25%

50m rolls. The legendary WHOPPER! High power, high quality for no compromise audio systems.

$60/50m RRP $80/50m **W 2130**

Quick test LAN cables!

This LAN tester will ensure you never have a bad cable on your network ever again! Its LED readout displays the status of all 8 conductors of any LAN cable.

Automatic or manual modes make it easy to troubleshoot bad connections. Suits most common network configurations. Includes carry case.

$55 RRP $69.95 **D 3907A**

Remote terminator clips onto the tester for easy storage!

8 in 1 Remote

Sick of losing your remotes under the couch? Well **COMBINE THEM ALL** into this single slimline learning remote control. Features 32 storage keys for each device plus one programmable macro key.

$45 RRP $59 **A 1006**

Discrete & compact security camera

Fitted with a 360° swivel bracket for accurate positioning. This compact **colour** camera produces a sharp image from its CCD sensor. Great for entryways or shops.

$220 RRP $269 **S 9135A**

Add wireless connectivity to your new camera by simply adding the S 8760 featured below to your system!

Install a camera up to 100m away with NO wires

$160 RRP $179.95 **S 8760**

This 2.4GHz transmitter and receiver provide a simple way to add wireless connectivity to your security cameras.

Easy plug & play installation

This means theres no need to run awkward & expensive cabling to your camera! They are also perfect for transmitting DVD player signal to another room, or from an AV source to a projector. Requires M 9236 plugpacks ($12.50) & M 9187 adaptors ($1.30).

Lockable Aluminium Cases

Tools not included

$39 Custom **T 5000**

$44 RRP $49 **T 5020A**

$79.50 CD Case **T 5010**

Keep your equipment safe & organised!
T 5020A: 460 x 325 x 150mm - Perfect for tools!
T 5000: 330 x 230 x 90mm - With customisable inner foam
T 5010: 430 x 245 x 175mm - Holds Approx 60 CD's.

Beware of inferior quality cheaper models on the market which have plastic sides and are less robust.

Bluetooth Networking

Simply by plugging this tiny unit into a spare USB port on your PC you can communicate wirelessly with any number of Bluetooth enabled devices. This is a popular way to update your home or work computer with data stored on your PDA, mobile phone, laptop etc. Drivers for 98SE, ME, 2000, XP provided. 10m range.

NEW

$45 RRP $49.95 **D 0380**

Save over 30%!

$99 RRP $149 **C 0900** White **C 0901** Black

6.5" 30W 2 Way Ceiling / wall flush mount: Expand your home audio system with these professional quality speakers which look and sound fantastic. They are well suited to home theatre / hi-fi use. The average home handyperson could install these in around an hour, its just that easy! **Sold in pairs.**

Get your sound system ready for summer!

These compact wall mount 2 way speakers (30W 8Ω) sound fantastic indoors or out! Aluminium brackets & grills mean they can easily be mounted under eaves, patio's and entertainment areas. Also fantastic as computer speakers, extension speakers, or in surround sound systems. Sold in pairs.

All feature aluminium brackets & grills: Take your sound outdoors or on the boat!

$179 RRP $219 **C 0673** Round

$200 RRP $249 **C 0671** Rect.

MAKE YOUR MESSAGE HEARD WITH THE...

MINI PORTABLE PA!

WITH IN BUILT 16 CHANNEL WIRELESS MIC RECEIVER
Compact, lightweight & very easy to use, it is incredibly portable. Featuring a high efficiency speaker and amplifier, this self contained mini PA system is fantastic for clubs, carnivals, rallies, demonstrations, announcements, spruikers etc. Microphones to suit:
C 8872 Handheld: $230
C 8875 Beltpack: $175
C 8907 Lapel Mic (to suit C 8875): $85
C 0383 Wired Mic: $45
Powered by 6 x C cell batteries or 240VAC or 12VDC.

$219
C 6998

NEW Wireless microphone receiver allows you to roam up to 30m away while speaking!

Due in stock in early August, secure yours today!

Cheap insurance for your valuable appliances

Protect your equipment from damaging surges and spikes. *Not available at dealers.

SAVE UP TO 49%
Great for protecting modems,TV, HiFi etc

	1 Way+Phone	6 Way	6 Way+Phone
	P 8131	P 8141	P 8151
Each	$10	$15	$20
Normally	$19.50	$27.50	$30

Prevent Permanent Battery Damage

$29.95
N 0700

Tired of forking out $100+ for batteries when you leave your car or boat sitting for a few weeks? Simply by connecting this solar maintainer (while charge is still high) will ensure your battery is always topped up. This results in better battery condition & longer life. This is an essential if your leaving the car behind while on holiday.

Great for cars, boats, yachts and caravans!

4 Ch. Digital Video Recorder

$719
S 9344A

This state-of-the-art digital video recorder provides an easy way to record footage from up to 4 cameras without VHS tapes. It's wide range of settings (compression, frame rates & recording modes) means it is very flexible. With a pair of 120Gb drives (D 5520 $225), this unit will record **over 300 days of footage!**

NOT JUST A DIGITAL VIDEO RECORDER!
This single unit acts as a switcher, quad processor, alarm triggering & footage playback device!
SAVE A FORTUNE ON BUYING SEPARATE DEVICES!

Upgrade the old mercury thermometer

A good quality thermometer should be in every family first aid kit.
It is an essential when monitoring illness and levers. With the advent of digital technology, now there is no need to rely on old glass thermometers which can break easily, take long periods to measure and are difficult to read. This unit takes measurements within 20 seconds & provides an audible fever alert if the temperature exceeds 37.5°C.

$12.50
X 4035

Too many devices, not enough inputs?

This versatile remote control AV switcher allows you to split a single input into 3. This makes it incredibly easy to switch between all of your AV devices such as game consoles, camcorders, VCD, DVD, DVDR etc. With SVHS, RCA and optical (toslink) inputs/outputs it will suit most AV equipment. ***No longer will you have to fumble at the back of your hi-fi unit switching inputs around! The A 3070 will neaten up your AV system forever!***

$125 RRP $149
A 3070

Get some use out of that old telly!

Adds a standard RCA AV input to older televisions with antenna input. Great for use with DVD, VCR, game consoles, security cameras etc. Sets to VHF channel 3. **Includes plugpack and PAL male to F male lead.** Limited stocks.

$26
S 9232

12pc Ratchet Screwdriver

Super fast ratchet action. Fantastic for the car, boat or caravan! Or anywhere you can't take a full tool kit! Contains various size, philips, blade & star tips

$19.95
T 2165

AN ENTIRE SCREWDRIVER SET IN ONE!

Move data *FAST* between PCs

$22 RRP $26.95
D 5500

Great for data backups, moving your data from home to office, or swapping data with your mates. Allows you to switch hard drives quickly and easily. ATA133 **Features:** Power & HDD activity LEDs, fan cooling. Suits any IDE device.

Buy a pair and store your spare/archive drive in its own caddy!

Turn one AV input into THREE!

With the A 3058 you'll no longer have to fumble behind your entertainment unit just to switch your AV inputs around! Great for connecting game consoles, DVD, VCR etc. RCA and S-Video input/outputs. ***NO POWER SUPPLY REQUIRED!***

$19.95
A 3058

Stock up on switches!

Premium quality push button switches and PCB toggle's. *10 pack. See website for contents.*

$12 RRP $25
ZX1200

SAVE OVER 50%!

SUPERBRIGHT LEDS

HUGE 6500 MCD OUTPUT!
12 degree viewing angle. White light. Great for projects, mini torches, kits etc. 5mmØ.

10 for $30 RRP $38.00
Z 0876A

BUY IN BULK AND SAVE OVER 20%!

Autoranging DMM WITH TRUE RMS

This True RMS capable multimeter has features usually only found in meters twice the price! It is capable of measuring AC waveforms with high accuracy and because it's autoranging, you can use it with one hand!
PACKED WITH FEATURES: • ACV & DCV to 750V • 10A rating (AC or DC) • Resistance to 40MΩ • Capacitance to 100µf • Temp to 1000°C • Continuity • Frequency to 10MHz • Diode test • Auto power off • Rubber holster & test leads included. • Data hold & relative modes

$79
Q 1073

Take body temperatures without fuss!

Accurately measure and display body temperature in seconds, at the push of a button! Great for checking kids, even infants - no pain or annoyances. With 20 disposable hygenic covers. **An essential addition to the family first aid kit.** X 4031 spare hygiene covers Pk40 $8.95

$35 RRP $39
X 4030

Takes the hassle out of taking body temperature from infants to adults!

A novel way to monitor your body fat level

$19.95
X 4029

Monitor your health & fitness

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$89.95 **K 9300**

NEW

HIGH EFFICIENCY LED POWER SUPPLY KIT

(SC Jan '04) This **high efficiency** switch-mode power supply will run a 1W LED from 2 "D" Cell batteries for **20 hours!** It's on board brightness control allows easy adjustment for any requirement. Great for low voltage lighting in a caravan or boat!

$42.50 **K 1000**

BONUS BUY: Buy the K 1000 kit and your choice of 1W Luxeon (Z 0690 or Z 0691) for **$50! SAVE $9.45!** (K 1000S or K 1000T)

POWER LEDs UP TO 5 WATTS!

NEW

(SC May '04) Powers up two 1W/3W LED's or a single 5W LED. The unique switching regulation employed means that it is very efficient and produces very little heat. Its 12V input makes it perfect for boats, cars & caravans, anywhere low voltage lighting might be required!

$29.95 **K 1010**

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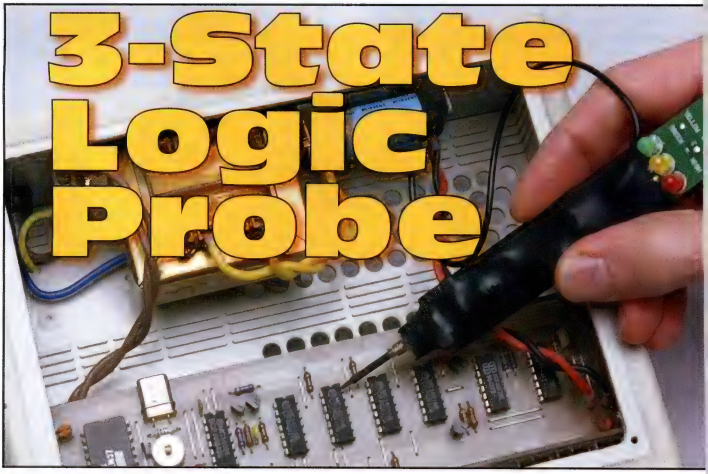
3-State Logic Probe



Back in the November 1998 edition of SILICON CHIP, we described a very handy 3-LED Logic Probe.

The circuit is just as viable today as when it was published six years ago and literally thousands of kits have been sold. That's no surprise: a logic probe is one of the "must have" test devices in any hobbyist's, technician's or even engineer's test equipment armoury.

What's more, it's cheap – so it's an ideal beginner's or school project (not to mention one that will come in very handy over the years)!

So why re-invent perfectly good wheels and present it once again?

Simple: one of the suppliers of the afore-mentioned kits, Altronics, reasoned that the it could be be made even better by re-designing the PC board to a handier shape, adding a few extra (low-cost!) components to provide better input protection, moving the supply on-board and finally, housing the probe so it was much more like . . . a probe!

(The original project was housed in a small plastic case which was a little unwieldy to use. It also had clip leads to connect to power on the device under test. The newer design doesn't have a case at all: it's housed in heatshrink. But we're getting a little ahead of ourselves.)

And the best part of all – it's even cheaper. With no case to worry about, the total cost of the new design has been kept at less than ten dollars. Yep, go without one packet of coffin nails and you can buy yourself a logic probe kit!

All right, what's a logic probe?

As its name suggests, a logic probe is a device which indicates any logic state at its input probe. Now that makes sense, doesn't it? Of course, there is just a little more to it than that.

First of all, the logic level should only be low (at or very close to ground) or high (at or very close to the positive supply).

But a faulty device can have an output level somewhere around between these limits, or even bouncing back and forth between them.

Ideally, then, a logic probe should be able to indicate all three circuit states – high, low and something else – and that is what this simple design does.

It has three LEDs which are readily visible, located near the top of the probe. The green one indicates a low level, the red one a high level and the yellow one is lit whenever the level changes from high to low.

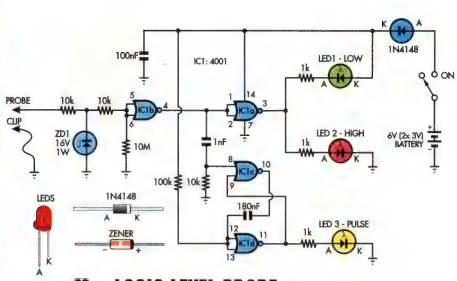
You may wonder why we bothered with the yellow indication. We have just stated that if the level is low, the green LED will light, if the level is high the red one will be lit, and if the level is changing from high to low then obviously both will light.

The fault condition described above can sometimes cause both LEDs to come on and this would give us a false indication. The yellow LED needs a full high-low transition to light it, thus eliminating any false indication.

How does it work?

As you can see from the circuit there is not much to it. A 4001 quad 2-input NOR gate is used as the logic level sensing device and also the LED driver. This particular chip also lets us make a monostable by cross-coupling two gates. We'll get to why we want that in a moment.

So let's start at the input. The probe



SC 2004 LOGIC LEVEL PROBE

One IC, three LEDs and a sprinkling of other components are all it takes to make a versatile Logic Probe. At left we are using the probe to check out the very first project ever published in SILICON CHIP, a 1GHz Digital Frequency Meter from November 1987. Yes, it still works perfectly!

tip is connected to pins 5 & 6 of IC1b via an input protection circuit consisting of two 10kΩ resistors and a 16V zener diode.

This will protect the rest of the circuit from very high level inputs voltages – up to around 300V – though what you would be doing using a logic probe with this level of input we're not sure. Still, for the sake of two resistors and a zener it's worthwhile protection.

The 10MΩ resistor holds the gate inputs low and prevents their input capacitance being charged and staying high when the probe encounters a momentary high level.

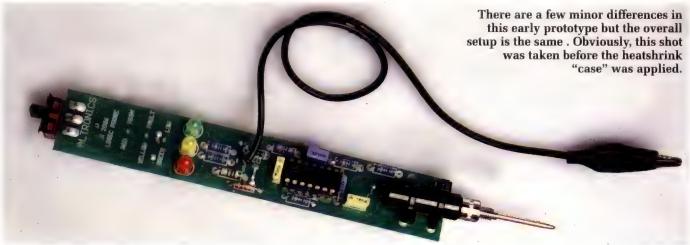
The output of IC1b is fed to pins 1 & 2 of IC1a which in turn, drives the LEDs. Since each gate effectively inverts its input and there are two gates, signal inversions via these gates, the output of IC1a is in phase with the input.

Thus when the input is low, the output of IC1a is low and the green LED will be lit. When the input goes high, the green LED will go out and the red one will light.

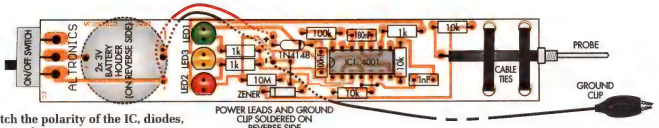
The output of IC1b is also coupled through a 100nF capacitor to one input of IC1c. This input is held low by the 10kΩ resistor to ground. IC1c's output, pin 10, is coupled via a 180nF capacitor to the inputs of IC1d. These inputs are held high by the 100kΩ resistor which means the output at pin 11 will be low.

A low to high transition at the output of IC1b will pull pin 8 of IC1c high and consequently pin 10 will go low. This will pull pins 12 & 13 low, taking pin 11 high and thus turning on LED3. As pin 11 is also connected to pin 9 of IC1c, it will hold the output of IC1c low even after the initial logic signal at pin 4 has charged the 1nF capacitor.

The yellow LED will stay lit until the voltage on the 180nF capacitor, which is charging through the 100kΩ resistor, reaches the switching threshold of IC1d. When it is reached, the output of IC1d will go low, the yellow LED will extinguish and the output of IC1c will go high again.



There are a few minor differences in this early prototype but the overall setup is the same . Obviously, this shot was taken before the heatshrink "case" was applied.



Watch the polarity of the IC, diodes, LEDs and Zener.

Thus each high to low input transition will flash the yellow LED for 18ms. At low frequencies this is readily apparent but as soon as the input frequency is high enough, the LED will appear to be lit continuously.

So to sum up, if the green or red LED is on, the circuit being measured is indicating a valid logic condition (ie, low or high), although if you want a high and you get a low you obviously have a problem.

A yellow LED on may mean a fault or it may mean a pulse train – either way, you know there is something to investigate.

Power for the Logic Probe is "on-board": a pair of button cells in series gives 6V. Diode D1 protects the logic probe if you accidentally put the cells in around the wrong way. The voltage drop across this diode means that the supply is closer to 5V than 6V.

Note that the "ground" clip lead must be connected to the ground or 0V of the circuit in order to give the logic probe its ground reference.

PC board assembly

The new PC board is deliberately made as small as possible to make it a comfortable fit in the hand.

Once assembled, the board is covered with a length of heatshrink tubing, leaving uncovered only the LEDs, battery and on-off switch at one end and the probe at the other.

The assembly details for the Logic Probe are quite straightforward. Start with the resistors and capacitors, as none of these are polarised. The battery holder and on-off switch are next, soldered directly the appropriate pads on the PC board.

Next come the three LEDs – make sure they are not only in the right place, but the right way around – and finally the 4001 IC. The IC, like everything else, is soldered directly to the PC board (ie, no socket) as this keeps the height at a minimum.

We used a probe from an old multimeter lead as the input prod but failing this, a nail or a small gauge screw with a filed point could be pressed into service. We're sure your ingenuity won't fail you here.

Testing

Insert the batteries into their holder and turn the on-off switch to on. The green LED should immediately light. If it doesn't, you have a problem somewhere in the circuit (dry joint, bridged track, etc) which needs to be found and fixed.

Use your multimeter to measure the voltage at pin 3 of IC1a. It should be at ground potential, ie, 0V.

Now short the probe to the probe's positive supply using a short length of wire or clip lead. This should extin-

Parts List – 3-LED Logic Probe

1 PC board, 20 x 133mm, coded K-2586 (Altronics)
1 length 30mm heatshrink tube, ~100mm long
1 miniature slide switch, SPDT (SPST also acceptable)
1 battery holder, PCB mounting, to accept two CR2016 cells,
1 length black hookup wire, ~250mm long
1 length red hookup wire, ~50mm long
1 insulated alligator clip
1 probe similar to multimeter probe (see text)
2 small cable ties

Semiconductors

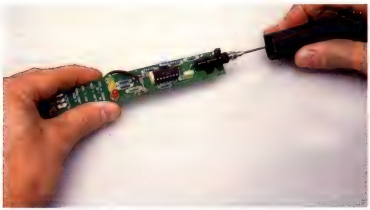
1 4001 quad NOR gate
1 1N4148 or similar Silicon diode
1 16V, 1W Zener diode
1 red 3mm or 5mm LED
1 green 3mm or 5mm LED
1 yellow 3mm or 5mm LED

Capacitors

1 180nF polyester
1 100nF polyester
1 1nF polyester

Resistors

1 10MΩ
3 10kΩ
1 100kΩ
3 1kΩ



Once the probe is built and tested, cut the heatshrink to an appropriate length (ie, LEDs to probe) . . .

. . . and shrink it with a heat gun on low setting (a hair drier also works, just not so quickly).

Where from, how much . . .

While the original design remains the copyright of SILICON CHIP, this PC board pattern was developed by Cameron Costigan at Altronics and this particular kit (K-2586) is available exclusively from Altronics stores, mail order (1300 797 007) or web (www.altronics.com.au) for just $9.95 plus p&p.

guish the green LED and light the red one. As you remove the probe from the supply, you should see the yellow LED flash briefly. Tap the wire to the probe a few times until you see it.

In use

It really is as simple as connecting the ground clip to the 0V (or ground) of the circuit under test, applying the probe and noting the LED colour.

For testing most 5V logic circuits, the 6V supply of the probe will be very close to perfect, especially as 0.6V will be lost across the protection diode.

Therefore logic high and low will be correct.

If you want to use it on a logic circuit with, say, a 12V or 15V supply rail, the logic levels for high and low will obviously be different.

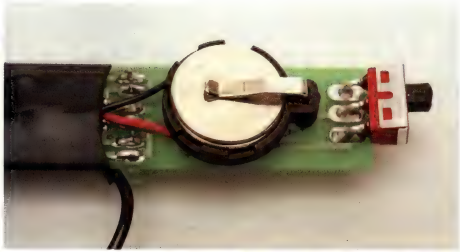
In some cases, a "low" may be above the probe's threshold and falsely give a "high" reading.

In this case, we suggest you revert to the arrangement used in the original circuit and take the supply from the circuit under test. That way, the logic thresholds will move to track the supply. You can use any supply rail up to 15V.

Provision is made on the PC board for attaching external supply lines. If you use an external supply you should first remove the on-board batteries.

The probe will work with most logic devices, particularly the now-pretty-standard CMOS chips ("C" and "HC" devices), as well as older TTL chips.

The upper frequency depends on the supply voltage: with the on-board batteries it should be good for up to about 3MHz or so; with a 15V supply perhaps 8-9MHz. SC



This view is of the back of the PC board showing the battery mounting. Naturally, the battery must not be covered by heatshrink!

And finally, the finished probe, complete with ground connector and heatshrink "case".

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Vintage Radio

By RODNEY CHAMPNESS, VK3UG

Peter Lankshear: vintage radio from the other side of the ditch

The title "Vintage Radio by Peter Lankshear" headed an accurate, informative column that ran in "Electronics Australia" magazine from June 1988 until September 1996. The column was highly respected on both sides of the Tasman due to the author's vast knowledge of the subject.

I have corresponded intermittently with Peter over the years and late in 2003 I had the opportunity to visit him in Invercargill, New Zealand. The weather in Invercargill at the time was cold, wet and windy – a complete contrast to the warm reception I received.

Peter was born in 1928. His father actively encouraged his interest in things electrical and radio and by the time he was 11, he knew that his life's work would be in this field. Around this time he built his first radio, a single-valve tetrode model "Hiker's One", using a 49 valve. According to Peter, he has had a soldering iron in his hand ever since.

Peter has a very inquiring mind and this has stood him in good stead throughout his career in electronics, television and radio. He qualified as a Registered Engineering Associate in Electronics, and with his enthusiasm and ability he eventually became the Broadcasting and Television Transmission Superintendent for Southern New Zealand with the New Zealand Broadcasting Service. He held this position for 15 years.

NZ vintage radio enthusiast Peter Lankshear.

Shown here are just two of Peter's Atwater Kent receivers, the Atwater Kent 317 (left) and the "Golden Voice" 84. The 317 used all metal valves and was one of the last models made, while the "Golden Voice" 84 (1930/1) was the first Atwater Kent receiver to use an arched cabinet.

Quartz Hill Receiving Station

Among his many and varied work activities, he was closely involved with the New Zealand government's Quartz Hill Receiving Station during the 1950s. This station would have been equivalent to the Australian Communications Authority's Quoin Ridge monitoring station near Hobart.

Primarily, these stations monitor shortwave radio transmissions from around the world. They can hear stations we can only dream of hearing due to their superior receivers, high-gain antennas and low noise locations. They also have facilities for direction finding of radio transmissions.

At Quartz Hill, the search radios were Eddystone type 680 communication receivers. As a result, Peter developed a keen interest in Eddystone

receivers and has quite a few in his collection (see photos). He also belongs to the Eddystone Users Group and often writes articles for their magazine, which is called "Lighthouse".

During the course of our conversation, Peter informed me that he is now gradually reducing the size of his collection because, as he pointed out, he isn't getting any younger. He subscribes to the view that as we get older, we should each look at ways of reducing our collection so that it is not left to people who have no interest or knowledge of our radio heritage. If that's not done, our collections could easily end up in the rubbish tip.

I mentioned to him that I had recently written an article on this very subject, in the May 2004 issue of SILICON CHIP. That said, Peter is keeping his favourite receivers, mostly Eddystones and Atwater Kents – he is only disposing of the sets that hold less interest for him.

Atwater Kent receivers

Atwater Kent receivers form the most impressive section of Peter's collection. In Australia, the importation of foreign-made radio receivers was allowed until 1932. However, after 1932, the popular Atwater Kents and all other imported sets were no longer allowed entry. This denied Australians the opportunity to purchase some of the very advanced receivers that became available in the following 4-5 years.

By contrast, New Zealand did not prohibit the importation of foreign receivers until 1936, so some quite advanced receivers did find their way into that country, particularly the later Atwater Kents. The cabinets of these receivers were quite elegant, as can be seen in the photographs, and the electronic design of the sets was cutting edge – just two of the reasons Peter concentrated on this particular manufacturer for his collection.

He described the Atwater Kent receivers and their manufacturer (Arthur Atwater Kent) in considerable detail in the September 1996 issue of "Electronics Australia".

She'll be right

If we were to go through the Australian Official Radio Service Manuals (AORSM), we would see that many Australian receivers made up until the 1940s lacked AVC/AGC and

Shown here are an Atwater Kent 217 at left and at right, an Atwater Kent 165. The latter featured an 8-inch speaker plus the American "Police Band", which was around 1700-1800kHz. Tuning the "Police Band" usually involved using tapped broadcast band coils, to achieve a slightly higher frequency tuning range than available with the standard coils.

The Atwater Kent 627 also featured an arched cabinet.

The Atwater Kent 708 was a high-performance receiver, built in 1933. It tunes from 550kHz to 20MHz in four bands & features separate local oscillator & mixer valves, an RF stage & a 2-stage (472.5kHz) IF amplifier.

An Eddystone 750 double-conversion 5-band communications receiver. The set tunes from the broadcast band to 30MHz.

Above: this Western Electric moving-iron speaker measured about 2'6" (760mm) in diameter and was used in the original New Plymouth radio station in 1928.

Left: built in 1934, the Atwater Kent 447 console receiver tuned from 550kHz to 23MHz in four bands. A split stator tuning capacitor is used to provide band-spread on the shortwave bands. The set also features an RF amplifier and a number of refinements to assist in accurate tracking and dial scale calibration. These include semi-circular dial scales that are raised or lowered with the band-change switch, so that the appropriate scale is visible through the dial escutcheon. The window at the bottom of the dial escutcheon is for a "tuning" meter.

had poor selectivity. Or to put it more bluntly, they simply lacked good design features. It really was a shame that some Australian manufacturers didn't venture out into the world (either in person or via magazines and books) to acquire good electronic designs for their radios.

Of course, we did have some very good design engineers but overall, there was too much of the "she'll be right, mate" attitude. However, let's not bag just the mediocre designers in Australia. There were also plenty in America and New Zealand whose designs left a lot to be desired.

Another Eddystone receiver, this time a model 640. This was one of Eddystone's first post-war receivers (1947) designed for amateur radio operators and covered from 1.8-31MHz. It boasts electrical band-spread, two dial pointers and a total of nine octal valves.

As noted in my article on the Astor OZ in the March 2004 issue, the design of valve receivers in the USA at least had almost reached its zenith by the mid 1930s. The only improvements from then on were in valve types, the use of permanent magnet speakers, and smaller and more efficient components and coils. However, the circuitry did not change to any great extent, even towards the end of the valve era.

Philips Theatrette

Although it is quite evident that Atwater Kent and Eddystone receivers hold particular importance to Peter, he also has some other very interesting receivers. These sets include a Philips Theatrette V7A, a Browning-Drake, a Majestic, an RCA (Radiola 20) and the New Zealand-made Bell Colt. All are very collectable receivers, with perhaps the Bell the odd one out because it's a 50s/60s Bakelite mantel receiver.

In fact, this set was manufactured between 1951 and 1971, being New Zealand's best selling radio ever. Naturally, a large number of Peter's sets appeared in his articles for "Electronics Australia".

I remembered the Philips Theatrette

The bottom receiver in this photo is an Eddystone 940, a 13-valve 5-band communications receiver which tunes from the broadcast band to 30MHz. This was the last of Eddystone's valved receivers and used a twin-triode cascode RF amplifier for low noise. The top unit is an Eddystone 870, a 5-valve ship's cabin receiver covering 150-300kHz and 510kHz to 24MHz in four other bands. This receiver was not considered a communications receiver, as it was used solely for entertaining the ship's crew.

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Made from 1925, the Radiola 20 was RCA's first TRF receiver. It uses the UX199 and UX120 valves, along with three ganged tuning capacitors plus adjustable trimming capacitors for tweaking the tuning. The righthand thumbwheel dial is the regeneration control.

from Peter's article and in fact, had the opportunity to acquire one some time back. However, I declined the offer as the set had been "ratted" for some parts and I didn't have a circuit to help with the restoration. Peter commented that the wiring was like a "dog's breakfast" and there was no chassis! However, they worked well, sounded good into an 8-inch (200mm) loudspeaker and rarely required servicing.

They also had the rather unusual intermediate frequency (IF) of 125kHz. However, it must be pointed out that this wasn't considered so unusual in Europe. It also simplified the circuitry, as "up-conversion" to 455kHz (or a similar IF) was not necessary.

Peter and I also discussed the attributes of "space charge" tetrodes such as the A141 and in particular the 49 valve, which was used in a number of configurations. The 49 was not really designed as a space charge tetrode but experimenters and hobbyists found that it worked well in that mode. It was used in the Hiker's One and Alf Traeger used it in some of his pedal radios which were used in the Australian outback.

I had commented in my soon to be published book "Outback Radio – from Flynn to Satellites" that I felt Traeger had not used the valve to its

Left" a Philco 18B 8-valve arched-top 1934/5 receiver. Peter retrieved this set from a country rubbish tip in a very sorry condition. The audio output section of this model was a cut above most, boasting a pair of 42 valves connected as triodes in class AB2 and driving a 200mm (8-inch) loudspeaker. This output stage was driven by another 42 valve.

Photo Gallery: 1933 Van Ruyten B14

Manufactured by Tilbury & Lewis Pty Ltd, Melbourne, in 1933, the Van Ruyten B14 circuit was conventional for the time, except that the high-tension voltage for the rectifier was obtained direct from the mains rather than via a separate winding on the power transformer. As a result, one side of the mains was connected directly to the chassis. The valve line-up was: 6A7 frequency changer; 78 IF amplifier; 6B7 audio amplifier/detector/AVC rectifier; 42 audio output; and 80 rectifier. Photo: Historical Radio Society of Australia, Inc

full potential. However, Peter showed me an early valve data book which set out how the valve could be used to achieve various outcomes. As a result, I had to amend a small section of my book prior to publication.

By the way, short-form valve data books such as Philips' "Miniwatt Technical Data" are extremely useful for obtaining the standard operating parameters of a valve. However, they generally do not give some of the more obscure parameters which can make a valve adaptable to a variety of other functions.

It just goes to show that old valve data books can be extremely valuable; so don't throw them out.

The Eddystone 680 is a 15-valve 5-band communications receiver, again tuning from the broadcast band to 30MHz. This is one of the search receivers used by Peter at New Zealand's Quartz Hill communications station in 1950-1.

AC power supply

I mentioned to Peter that the AC power supply for battery sets that he described in "Electronics Australia" had been quite popular with vintage radio enthusiasts. It used the power transformer from an old black and white TV set.

According to Peter, the PC board for this project should still be available from RCS Radio. It is well made and has silk screen printing on the non-foil side to assist component placement.

Peter's small micro-powered broadcast transmitter has also been built by a number of enthusiasts. However, if you do build one, make sure that no transmissions can be received outside your premises!

Books & magazines

As expected, Peter has an extensive library of good books on vintage radio and on many other subjects that he's interested in. Books and magazines are well worth retaining, particularly the better quality ones. But even the not so good ones are worth keeping – they are all part of our radio history.

Peter is a life member of both the New Zealand Vintage Radio Society (NZVRS) and the Historical Radio Society of Australia (HRSA). He still writes for a number of publications, including the NZVRS "Bulletin", the HRSA "Radio Waves", the American "Old Timer's Bulletin", the British "Radio Bygones" and the Eddystone User Group's "Lighthouse".

He also has a number of other interests besides vintage radio. For example, he is the Southern Vice-President of the New Zealand Railway and Locomotive Society. He is also active in his local church, where he looks after a comprehensive sound reinforcing and recording system and produces the weekly "Church Bulletin".

Of course, it's not surprising that he became involved with the sound system as another of his electronics interests involves designing and building audio amplifiers.

In the end, my time with Peter was too limited and I would have liked to have spent many more hours with him discussing radio, electronics and vintage radio in particular. And I learnt quite a number of things from our very interesting discussion. **SC**

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Leakage problem in Railpower circuit

I have just built the RailPower Mk3 from the October, November and December 1999 issues and it works fine except for one problem. When completed, the maximum voltage could only be adjusted up to about 7V. Changing the 4.7MΩ resistor to 10MΩ allowed the maximum voltage setting to be adjusted from between approximately 6.5V and 15.5V.

The problem is that the 2.2µF capacitor in the voltage hold circuit connecting to pin 5 of the TL072 immediately drains, reducing the voltage from 10.5V to 0V in under one minute. I replaced the TL072 and double-checked the PC board for shorts and found none. Can you help? (T. D., Robina, Qld).

● There appears to be leakage on the PC board adjacent to the capacitor. Change the capacitor and clean the PC board with methylated spirits and a toothbrush.

RF modulator for a DVD player

Have you ever done a project for an AV-to-RF modulator? With all these new cheap DVD players coming out, they don't have an RF output; only AV which doesn't suit the older TVs with only an RF input. (K. R., via email).

● Making your own modulator is not worthwhile since you can buy the finished product so cheaply; eg, Jaycar Cat. LM-3872. Alternatively, you can connect the A/V signals from your DVD to a VCR and thence to your TV.

Problem with Theremin kit

I recently assembled a Theremin kit (SILICON CHIP, August 2000) and it went for a few minutes – just long enough to verify that the pitch antenna was working. I was looking at setting up the volume as per the instructions but then it stopped working.

I've pretty much tracked the problem down to the pitch oscillator. Specifically, the voltage at the drain pin of Q2 (2N5484 transistor) is 0V. I figure it should be similar to the drain pin of Q1 in the reference oscillator, which I measured at about 5V.

I'm guessing that Q2 is dead but I'm not electronics-savvy enough to be sure (I did check the associated 1kΩ resistor and 0.1µF capacitor – they're both OK). Or possibly it might be the T2 coil, I guess.

I have a scope and checked the other oscillators – they all seem to be working OK. Do you have any suggestion as to what component is faulty? If it is the transistor, can I replace it with either a 2N5457 or MPF102? Those are the only FETs available in my town. Or can I replace it with a bipolar transistor?

Other than swapping working parts from one of the other oscillators (which, given my relative inexperience with electronics would probably result in more problems), how can I identify the faulty part? (F. Q., via email).

● As you have guessed, the oscillator circuits within the Theremin are similar. So you can swap parts in the circuit to check which part is faulty. You can use an MPF102 for a replacement FET.

Presumably, if the drain on the FET is at 0V, the supply resistor is open circuit to the supply. Check the supply to the FET on the other side of the drain resistor.

Regulator for 6V battery charging

I am building the "Add-on Regulator for 12V Battery Chargers" kit (DSE K-3127), which was originally published in "Electronics Australia" in July 1997. My Battery Charger is an Arlec 6/12V (4A) Autocharger, which has selectable output voltage (6V or 12V) for charging 6V or 12V batteries.

I was wondering if the circuit can be modified (reasonably simply) so as to regulate for both 6V and 12V batteries. What changes do I need to make? (M. R., via email).

● In principle it should be possible to regulate for a 6V battery although we have not tried it. Change the two 3.3V zeners to one 4.7V type and then adjust to regulate to 6.9V for a 6V battery.

Astor Diamond Dot circuit wanted

I am after a circuit diagram for the Astor Diamond Dot 11-transistor car radio that was produced in the 1960s.

Safe Battery Charger For Cars

I cannot recall seeing a project for a charger for 12V car batteries that can be connected to modern cars with alternators, stereo system, security systems, etc, without having to disconnect the main battery leads first. However, each time these leads are disconnected, it is a chore having to reprogram radios, clocks and other battery powered accessories.

A charger that is safe to connect to car batteries and their connected loads would probably be widely welcomed. If such a project is feasible, it would be ideal if it could be based on commercially available chargers. This would avoid problems with mains wiring, cases, battery leads, etc. (I. P., via email).

● We know of no reason why you should have to disconnect your car's battery when you connect a mains-powered charger. On the rare occasions that we have charged our cars' batteries, we have not done so. Nor do the owners' manuals for any of our company cars have a recommendation to disconnect batteries when charging.

I would pay for photocopying, postage, etc.

I have been a subscriber for many years and enjoy the publication. I have to admit that it is a bit frustrating to read the construction articles and not have time to build very much! Richard Penalurick, 4 Neilson St, Garran, ACT 2605. Email: **richard.penalurick@defence.gov.au**

- First port of call for this sort of query should be to the Historical Radio Society of Australia, PO Box 2283, Mt Waverley, Vic 3149. **www.hrsa.asn.au**. Provided you are financial member, the cost of such circuits is minimal.

Smart Mixture Display for diesel engines

After reading about the Smart Mixture Display in April 2004, I wonder if it will work with turbo diesel engines or does it need modifications?

I lost a diesel motor last year to much the same problem as outlined in your article and want to know if this kit will help diagnose the problem if this event happens again. Instead of eating through the valve like in the Subaru Impreza, the lean mixture burnt a hole through the piston. (D. K., Innisfail, Qld).

- The Smart Mixture Display will work on a Diesel engine if it has an oxygen sensor.

PIC programmer voltage problem

I recently built the PIC Programmer and Testbed described in the January 2001 issue and I am having problems with it. On the MAX232 (IC1) I was originally getting only -4V from pin 6. I found a schematic of the IC on the net, however it just said that there was a voltage inverter between pins 2 & 6.

I was wondering what could be causing this problem. (B. P., via email).

- There is indeed a voltage inverter between pins 2 & 6 of the MAX232 IC. What this means is that if you only have -4V on pin 4, then you probably only have about +5V on pin 2.

This lower than expected voltage could have a number of causes, as follows: (1) The chip is faulty (unlikely); (2) a component is in the wrong place or not soldered properly; (3) one of the MAX232 outputs is overloaded due to a fault elsewhere in the circuit (most likely).

Here are some ideas for tracking down the problem. Make sure that there is +5V on the supply pins to the MAX232 (pins 15 & 16). If not, the problem is in the 5V regulator circuit, not the MAX232. Next, double-check that you have all seven of the 1µF (coded 105) capacitors installed in the correct places. Also, check the orientation of diodes D3 and D4.

If all of these are OK, then disconnect the RS232 cable. A short-circuit or incorrectly-wired cable can overload the MAX232 outputs. Now measure the voltages again. If there is no significant change, then the fault is probably somewhere in the V_{PP} (+17.8V) generation or switching circuitry.

You can temporarily isolate the V_{PP} circuitry by lifting one end of diode D4. Now measure the voltages around the MAX232 again. You'll probably find that the voltages on pins 2 & 6 are now OK (perhaps even a little high).

Does Win XP Run DOS Programs Or Not?

I've been reading the recent articles about using the free PC board software packages available. Unfortunately, now that I've finally found the time to actually start trying to do some of this, I have a problem.

Last year I bought an Optima 2.5GHz Celeron with Windows XP (Home) from Dick Smith Electronics. I specifically asked the salesman if the unit had all the "legacy" connectors (parallel ports, etc) and whether it would run DOS programs. He replied to the effect that while they couldn't absolutely guarantee it would run every DOS application, most of them should.

To cut a long story short, after a lot of fiddling and driver downloading, I've reached the stage where I can run text-based DOS programs in an on-screen window but not in the 640 x 480 graphics mode that most DOS CAD programs run in.

It's not that the computer can't handle the graphics – the initial 640 x 480 screens always come up fine. The problem is that neither the mouse or keyboard will do anything in that mode! (Well, pressing Ctrl/Esc bumps you back to Windows but that's it).

After a long battle with the people in the Optima service department, I was eventually and flatly informed that "you can't run DOS programs under Win XP".

Is this true? Or is it: "you can't run DOS programs under Win XP on *this* computer"?

My only real question to you is: have you definitely seen Easytrax and similar programs running under Win XP? I understand about the printing problem but printing to a file is not a big deal for me.

So I just want to get my facts straight: can you run those CAD programs under Win XP (Home Edition)? If not directly, is there some software fiddle involved? At the moment, not a single one of my collection of DOS programs will work in DOS "full-screen" mode. (K. W., via email).

- Autotrax runs fine on our Windows XP installation, in both 640 x 480 and 1024 x 768 resolution modes. As described in the article, we suggest you try the updated Autotrax/Easytrax video drivers from Airborn Electronics, available at:

www.airborn.com.au/layout/easytrax.html

Try the lower-resolution modes first. If these don't work, try the alternative "modeforce" drivers as described in the Airborn documentation.

Your description of the problem suggests that your graphics card and/or video driver lack VESA support. Although VESA modes are a "hangover" from days gone by, many cards and drivers still seem to support them.

As you suggest, Traxedit (and many other DOS applications) can only run in full-screen mode.

Non-responsive mouse and keyboard problems can also be caused by an errant I/O port driver. These are often installed as part of the software packages used for controlling external devices such as PIC and PROM programmers, I/O port cards, etc. Uninstall any such software to eliminate them from the suspects list.

Is a firewall really necessary?

A few weeks ago, I succumbed to pressure from Optus to abandon phone-up connection to the web and install their broadband (cable) system. All of my friends said that I must now install something called a "firewall" because of the fact that I am now always on line and the nasties can jump in any time they like.

The cable modem that came with the cable installation has a button which allows it to be turned off (standby). When it is on standby, I can neither send or receive anything to or from the web.

I am seeking your advice as I seem to remember you wrote an article on firewalls some time ago which did not interest me at that time because I had dial-up web access. Because my modem can in effect be turned off and I am not on line any more than I used to be, I thought a firewall was unnecessary.

Could you advise me if, in your opinion, I do in fact need a firewall and if so, what would be a suitable choice?

Incidentally, I found a section of my computer which has a huge list of "cookies". Do I need these or can I delete them? (N. W., via email).

● If you connect to the Internet, then you really must have a firewall. This is more critical with a broadband connection because the high speed makes it that much easier for the bad guys to hack their way into your unprotected machine.

Which firewall to use? There are several to choose from and for home use, you could choose the freeware version of ZoneAlarm (available from **www.zonelabs.com**) or the limited free edition of Kerio Personal Firewall (see **www.kerio.com/kpf_download.html**). Another excellent "freebie" for personal use is Sygate Personal Firewall (**www.smb.sygate.com**).

Alternatively, you can buy the full editions of all these firewalls for extra features (eg, blocking pop-ups and VB scripts, etc).

These programs are easy to set up and get going. Typically, they set up some default firewall rules for you on installation (eg, to allow access for Internet Explorer, etc) and then prompt you to create additional rules via a series of pop-up dialog boxes each time you use a new program to access the Internet. If you are sure that you want to give the program access, you simply answer yes and create the rule; if not, you deny access and again create a rule. Once you've created the rules, the pop-ups stop.

Although adequate for general home use, our understanding is that the freeware versions of these programs do open holes when configured to allow Internet Connection Sharing (ICS). If you're not using ICS (ie, sharing the Internet connection between two or more computers), this isn't a problem.

Alternatively, you could use a commercial firewall program such as Norton Personal Firewall (about $75). This not only includes an excellent firewall but it integrates with Norton AntiVirus as well (eg, for such things as live updates). It's easy to install and get going and provides a high level of protection, even for ICS.

Other commercial products no doubt also work well although we don't have any personal experience with these.

Note that an anti-virus program and a firewall perform different functions and you need to have both installed. It's also important that you have all critical security update packages applied to your PC's operating system and you do that through the Windows Update utility. You should also have file and printer sharing turned off for the connection to your cable (or ADSL) modem.

As for cookies, you can get rid of them. Just open up Internet Explorer and click *Tools, Internet Options*, then click the *Delete Cookies* button. You can also delete any temporary Internet files and history files using this dialog box.

Finally, we recommend that you install and regularly run two spyware detection programs. These programs are called (1) "Adaware" and (2) "Spybot – Search & Destroy". They're both freeware and can be downloaded from their respective websites.

Alternatively, you'll usually find them on the CD-ROM (along with ZoneAlarm and Kerio Personal Firewall) that's attached to recent copies of *APC (Australian Personal Computer)* magazine.

In this case, the fault is somewhere in the +13.6V regulator (Q3, Q4, ZD1, D5) or the V_{PP} switching circuit (Q5-Q7). Initially, check that you haven't inadvertently mixed up the PN100 & PN200 transistor types and that the diodes are around the right way. Also, test Q6 to make sure it's OK.

Faulty sensor in Speed Alarm

Some years ago, I built the Speed Alarm kit and installed it in my L-series Subaru. I am now addicted to this device, as it prevents me from getting speeding fines. The Victorian police are red hot on speed limits these days and speed cameras are deadly.

Anyway, the Speed Alarm has developed a fault which seems to come on when conditions are hot or when the motor has warmed up. It seems unlikely that the control unit is faulty as I can change the speed settings and cycle through the normal display functions.

I constructed the speed sensor to your instructions and sealed it with Araldite. I then connected the shielded cable back to the control unit without any plugs or sockets.

How would you suggest I test the sensor to prove that is where the fault lies? I can not see myself mounting a socket on the control box so would I be best cutting the shielded cable near the control box and inserting a plug and socket to allow me to test with a multimeter after getting the sensor unit hot? (M. T., Donvale, Vic).

● The sensor should give a voltage output when the car is driven. Set the multimeter to read AC volts. It should give at least 3V of signal.

Is Shut that mutt OK near cats?

The "Shut that Mutt" project in the April 2004 issue caught my eye, as I have been suffering this neurotic poodle next door for several years. The owners are both deaf and despite repeated requests to keep the dog quiet, simply don't care.

However, I have a cat. Will this project cause discomfort to my own cat when activated or do cats have a different high-frequency response? (A. M., via email).

● Cats will not like it at all. If they are in the beam of the tweeters they will clear out at high speed. However, provided you aim the tweeters carefully, it should not cause your cat any problem.

PC remote control of media player

Thank you for your PC Infrared Remote Receiver project in the August 2003 issue. In a similar but less sophisticated vein, I would like to achieve foot-switch operation of the PAUSE function of Windows Media Player to emulate the function provided by a dictaphone.

Using compression (WMA 16K mono), I can get 30 minutes of cassette audio into less than 4MB on the hard drive and thus many days of conference recording will fit easily on a CD when archiving is required.

For a typist to transcribe these recordings using a computer instead of a dictaphone or cassette player requires only foot-switch control of the pause function of Windows Media Player and a headset plugged into the computer's audio card.

I thought this would be a simple project using a standard momentary-action foot switch into the computer's joystick input and Girder to provide the software interface.

Complexity arises because it is necessary for the momentary action of the foot-switch to be translated into the toggle action of the Media Player's pause button (foot-switch is held down for continuous play; play must return to pause when foot-switch released). I would be interested to hear what you think of this idea. (D. P., Forestville, NSW).

● It should be possible to do what you want using Girder, including the pause button "toggle" function. However, you'll need a joystick plug-in for Girder. This is not currently available, although a check of the Girder developer's forum reveals that one is in the pipeline.

When we published the PC Infrared Remote Receiver project, Girder was free. It is now being offered as shareware, with a 30-day evaluation period. A licensed copy of the product will set you back about $30. See **www.girder.nl** for more information.

Regulated 12V from a car battery

I have a requirement for a 12V supply regulated at around 1A. The equipment specifically states not to exceed 12.5V and I wish to run this off a car battery which can of course approach 14V when fully charged.

There are plenty of regulator circuits around for AC to 12V DC regulated, all of which appear to require a voltage difference of 2.5V between input and output. I came across an article on the web which explained in principle how this is achieved, in that the input DC voltage would be first increased to a suitable voltage (in excess of 14.5V) and then regulated down to 12V.

My problem is that I have no knowledge on how to achieve the first step of increasing the voltage and cannot find a circuit that would assist me. Has SILICON CHIP ever published such a circuit? (S. P., via email).

● Have a look at the DC-DC Converter project from the June 2003 issue. This can be adjusted to give between 13.8V and 24V out. You could set it to say 16V and then use a 3-terminal 12V regulator on the output

Notes & Errata

PICAXE-18X 4-Channel Datalogger, March 2004: in the Humidity Program listing (Fig.4 on page 80), saving the scratch-pad value back to the temperature word overwrites the whole degree value.

The fix is to preserve the LSB in a separate variable. That way, the stored data can be retrieved and simply multiplied by 0.0625 to recover the fractional temperature at full resolution.

A modified program incorporating this change is available from the SILICON CHIP web site.

Thanks to Ian Thompson for this suggestion. **SC**

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

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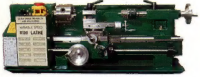

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NEW STOCK of old Radiometrix Products at www.radiometrix.com.au

Australasian distributors for M.K.Consultants (UK) Ltd

one of the world's most respected names in low power, off-the-shelf radio modules

The Genesis Wireless Connector

The worlds first medium RF bandwidth radio modules that offer wireless connectivity over a 1km range with data rates to 15kbps.

The FM Wireless Connector is not only suitable for your next wireless application, but its also suitable for upgrading the performance of your current product.

MKT5/MKR5 Transmitter/Receiver

With over 13 years of RF design expertise you can be sure that our modules wont let you down!

Wideband UHF SAW transmitter and matching superhet receiver offer a range of up to 350m and a data rate up to 128KB/sec. If you're thinking wireless, think MK Consultants and TeleLink!

NEW! Long Range VHF Transmit/Receive Modules

AND COMING SOON: GTR2 FULL FEATURE TRANSCEIVER!

Looking for long range? Look no further than the GT2 and GR2 VHF (151.3MHz) long range modules.

With high sensitivity (121dBm)/ high power (10mW) and high speed (up to 9600 baud), they're perfect for remote control, wireless monitoring, alarm/security applications, etc.

High Integrity FM Transceiver

MK Consultants "X" series transceivers offer the outstanding performance of PLL designs at SAW prices!

They're the ideal choice for all new wireless requirements, designed to give a a reliable wire free link into the future, accounting for the increased traffic from other users of the radio spectrum.

COMING SOON:

- ☑ New Bluetooth OEM Modules
- ☑ Development Kit for X2010 transceiver with on-board software chip
- ☑ 100mW GT2 VHF transmitter module for 151.300MHz and other VHF frequencies

SERVICES: We can now offer specialised Low Power Radio Module Design services, for high volume customer requirements.

Telelink Communications have a Low Power Radio Module solution for you!

Contact: Jack Chomley

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